California High-Speed Train Project

TECHNICAL MEMORANDUM / POLICY

Station Program Design Guidelines
TM 2.2.2

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Prepared by PB

for the California High-Speed Rail Authority

System Level Technical and Integration Reviews

The purpose of the review is to ensure:

- Technical consistency and appropriateness
- Check for integration issues and conflicts

System level reviews are required for all technical memorandums. Technical Leads for each subsystem are responsible for completing the reviews in a timely manner and identifying appropriate senior staff to perform the review. Exemption to the System Level technical and integration review by any Subsystem must be approved by the Engineering Manager.

System Level Technical Reviews by Subsystem:

Systems:	*Signed document on file* Rick Schmedes	31 May 11 Date
Infrastructure:	*Signed document on file* John Chirco	31 May 11 Date
Operations:	*Signed document on file* Joseph Metzler	31 May 11 Date
Maintenance:	*Signed document on file* Joseph Metzler	31 May 11 Date
Rolling Stock:	*Signed document on file* Frank Banko:	31 May 11 Date

Note: Signatures apply for the technical memorandum revision corresponding to revision number in header and as noted on cover.

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ABSTRACT

This technical memorandum identifies the facilities, designated spaces, design elements, and service amenities to be provided at passenger stations for the California High-Speed Train Project (CHSTP). This document presents design guidance for the programming and functional requirements of high-speed train stations in order to advance design so that the station's facilities and uses can be fully considered through the 30% Design level. This document does not define requirements for platform geometries or station sites. These issues are considered in other technical memoranda.

High-speed train passenger stations fulfill multiple roles. Stations must provide the required functional services for the high-speed train system, accommodate the needs of passengers, and support the administrative requirements for train operations. Safe, secure, and comfortable stations that are of high quality promote and encourage ridership are an important part of the high-speed train system.

The placement and flow between the specific elements and amenities that make up a station shall lead to logical internal movement and minimization of conflicts. Standardization of certain design elements for stations throughout the high-speed train system is important in order to simplify design, procurement, and maintenance. Certain stations will additionally require distinct facilities and amenities to reflect the type of station (intermediate or terminal), location and category of station, anticipated passenger demand, and the surrounding environment.

The following elements are considered in this memorandum:

- Station Design Considerations, including design principles and factors leading to variation between stations
- Station Program Requirements, including free areas, paid areas, circulation spaces and support areas
- Station Amenities, including furniture, signage and communication and fare collection equipment
- Station Systems, including building and systems that interface with trains

Station programs for currently operating high-speed train and conventional passenger rail services were considered in developing these standards and guidelines. Where appropriate, this memorandum reflects the current design practices in European and Asian systems for reference. The quantitative guidance in this document is based on the currently available information. It is recognized that the guidance in this document will require refinement during subsequent design phases.

This document does not define specific layouts or prescribe architectural design. While code and safety requirements are cited, actual design will require more thorough code assessment and application.

1.0 INTRODUCTION

1.1 PURPOSE OF TECHNICAL MEMORANDUM

The purpose of this technical memorandum is to set forth design guidelines and standards for passenger stations that promote safe, efficient, and high quality operations for high-speed train service. This memorandum presents information relating to functional space requirements, building amenities, station performance, circulation, connection, and safety of the patrons and employees of the high-speed train system. Where available, this information is based on present practices used worldwide and on current federal, state, and transit agency standards, guidelines and practices. Document searches were conducted to identify and present practices for existing or planned European and Asian station facilities and this information was used to define the CHSTP guidance that is included in this memorandum.

It is the intent of the Authority for these standards and guidelines to be followed in the design of passenger station sites and related facilities. Since the stations will be located in multiple municipal jurisdictions, other transportation owner/operators' rights-of-way, and/or unincorporated jurisdictions, the CHSTP standards and guidelines may differ from local jurisdictions' codes and standards. Although state agency projects are not subject to local city or county codes, the HST system is to provide for connection and integration with other passenger rail and transit services as well as the surrounding station area. In the case of such connections, consideration of local codes and other transportation owner/operators' guidance will be appropriate.

1.2 STATEMENT OF TECHNICAL ISSUE

This document presents design guidance for the programming and functional requirements of high-speed train stations in order to advance design so that the station's facilities and uses can be fully considered during the project-level environmental assessment and through the 30% Design level. This document does not define requirements for platform geometries, specific site layouts or prescribe architectural or aesthetic design requirements. These issues are considered in other technical memorandums. Station site design is addressed in the TM 2.2.3 Station Site Design Guidelines and platform geometries are addressed in the TM 2.2.4 Station Platform Geometric Design.

While code and safety requirements are cited, actual design will require a thorough code assessment and application.

1.3 GENERAL INFORMATION

1.3.1 Definition of Terms

The following technical terms and acronyms used in this document have specific connotations with regard to the California High-Speed Train system.

Accessibility: The ease with which a site or facility may be reached by passengers and others necessary to the facility's intended function. Also, the extent to which a facility is usable by disabled persons, including wheelchair users.

Alignment: The horizontal and vertical route of the high-speed rail guideway.

Americans with Disabilities Act (ADA):

Federal regulation establishing legal requirements for accessibility. The Act prohibits discrimination on the basis of disability in employment, State and local government, public accommodations, commercial facilities, transportation, and telecommunications.

At-Grade: At-ground surface level; used to describe roadways, river crossings, and track alignments.

Authority:	California High-Speed Rail Authority
Center Platform:	Passenger platform in-between two station tracks.
Concourse:	Interior station area between entrances and access to platforms or mezzanine. Portions of the concourse may be public or non-public, free or paid.
Design Guidelines:	Provide a preferred but not necessarily required direction for a particular design feature. Guidelines are designated with the word SHOULD.
Design Standards:	Indicate required directions for a particular design feature. Language relating to standards will typically include the word SHALL. An approved design variance is required for any deviation from the standards.
Fare Collection Line:	Demarcation between Free Area and Paid Area
Fare Gate Array:	Physical barrier which requires a valid CHST ticket to pass.
Fare Gates:	Devices for ticket processing.
Feasible:	Capable of being implemented.
Footprint:	Area of the ground surface covered by a facility, or affected by construction activities.
Free Area:	Areas within a station that are open to the public.
Headway:	The time between buses, trains, or other transit vehicles at a given point. For example, a 15-minute headway means that one bus arrives every 15 minutes.
High-Speed Train:	Refers to a train designed to operate safely and reliably at speeds near 200 mph (320 kph).
Intermediate Station:	Any station between two terminal stations. Intermediate HST stations will usually include additional tracks to allow for through running express services.
Level of Service (LOS):	A rating using qualitative measures that characterize operational conditions within a traffic stream and their perception by motorists and passengers.
Mezzanine:	An intermediate floor level typically situated between concourse level and platform level.
Non-public Area:	Station areas accessible only to station staff and secured against unauthorized entry with lockable doors.
Paid Area:	Areas on the platform side of the fare-paid line where possession of a valid CHST ticket is required.
Peak Period:	Time period during the day with the greatest volume of CHST patrons.
Platform:	Station area adjacent to tracks where trains stop to allow passengers to board and alight.
Public Area:	Station free areas and paid areas, accessible to the general public.
Queuing Area:	Station area where passengers wait or line up to use a device or circulation element such as a ticket machine, fare gate, stair, elevator, or escalator. Queuing areas should be designed to accommodate waiting passengers without disrupting other passenger flows. Also, area provided to accommodate peak passenger surges.
Ridership:	Number of passengers using CHST over a certain period of time

Shared Use Corridor:	Segment along the alignment where high-speed trains operate in or adjacent to right-of-way with conventional railroads, i.e. Caltrain, Metrolink, and Amtrak.
Side Platform:	Station area adjacent to a single track for the purpose of passenger boarding and alighting.
Station:	Areas within a station building envelope.
Terminal Station:	The first or last station of a passenger rail route.
Trainset:	A complete unit of rolling stock that makes up a single train.

Acronyms

ADA	Americans with Disabilities Act (Federal)
ADAAG	ADA Accessibility Guidelines for Buildings and Facilities
AHU	Air Handling Unit
ANSI	American National Standards Institute
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance-of-Way Association
ASME	American Society of Mechanical Engineers
ATM	Automated Teller Machines
Authority	California High-Speed Rail Authority
CBC	California Building Code
CCF	Central Control Facility
CCR	California Code of Regulations
CCTV	Closed Circuit Television
CFR	Code of Federal Regulations
CHST	California High-Speed Train
CHSTP	California High-Speed Train Project
CPUC	California Public Utilities Commission
DGS	California Department of General Services
DSA	Division of the State Architect, Department of General Services (State)
ECS	Environmental Control Systems
EIPB	Excellence in Public Buildings (State)
FE	Fire Extinguishers
FHC	Fire Hose Cabinets
FRA	Federal Railroad Administration
HST	High-Speed Train
HVAC	Heating Ventilation and Air Conditioning
IBC	International Building Code
IES	Illuminating Engineering Society
LEED™	Leadership in Energy and Environmental Design
LOS	Level of Service
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
OCS	Overhead Contact System
PCJPB	Peninsula Corridor Joint Powers Board
POL	Platform Occupant Load
PSB	Passenger Service Booth
SCRRA	Southern California Regional Rail Authority
sf / ft^2	square footTHSR Taiwan High Speed Rail
TM	Technical Memorandum
TSI	Technical Specifications for Interoperability (European Union's)
TVM	Ticket Vending Machine
UPS	Uninterruptible Power Supply
VOC	Volatile Organic Compounds

1.3.2 Units

The California High-Speed Train Project is based on U.S. Customary Units consistent with guidelines prepared by the California Department of Transportation and defined by the National Institute of Standards and Technology (NIST). U.S. Customary Units are officially used in the United States, and are also known in the U.S. as “English” or “Imperial” units. In order to avoid confusion, all formal references to units of measure shall be made in terms of U.S. Customary Units.

2.0 DESIGN STANDARDS AND GUIDELINES

2.1 GENERAL

This document provides guidance on elements of high-speed train passenger station design in order to establish general size and space needs for a new station or to be added to an existing station in order to develop station plans to the 30% Design level.

2.2 LAWS AND CODES

Design criteria for the CHSTP are under development. When completed, a CHSTP Design Manual will present design standards and guidelines specifically for the construction and operation of the high-speed railway based on international best practices and applicable state and federal requirements. Initial high-speed rail design criteria will be issued in technical memoranda that provide guidance and procedures to advance the design of project-specific elements. Criteria for design elements not specific to high-speed train operations will be governed by existing applicable codes, regulations, design standards and guidelines.

The CHSTP design standards and guidelines may differ from local jurisdictions' codes and standards. Because the Authority is an agency of the state government, development of buildings within the state's right-of-way should fall under the jurisdiction of the Division of the State Architect (DSA) and the State Fire Marshall along with input and coordination with local jurisdictions. Although state agency projects are not subject to local city or county codes, the HST system is to provide for connection and integration with other passenger rail and transit services as well as the surrounding station area. In the case of such connections, consideration of local codes and other owner/operators' requirements will be appropriate. In the case of differing standards for work outside of the state-owned right-of-way, conflicts in design requirements will be resolved by using the higher standard or that is deemed as the most appropriate by the California High-Speed Rail Authority (Authority). The standard required for securing regulatory approval will be followed. In addition to the Division of the State Architect and the Office of the State Fire Marshall, approvals may also be required from the Army Corps of Engineers, California Coastal Commission, Caltrans, and other agencies and authorities at specific locations.

Applicable codes, rules, standards and guidelines may include but are not limited to:

- ADA and ADAAG: ADA Guidelines for Buildings and Facilities and Part IV DOT, 49 CFR Parts 27, 37 and 38,
- ANSI 117.1 – American National Standards Institute standard for accessible design for persons with disabilities
- ASME A17.1 – American Society of Mechanical Engineers Safety Code for Elevators and Escalators
- NFPA 70: National Electrical Code
- NFPA 101: National Fire Protection Association's Life Safety Code, 2009 Edition.
- NFPA 130: National Fire Protection Association Standard for Fixed Guideway Transit and Passenger Rail Systems, 2010 Edition. IBC: International Building Code, latest adopted edition.
- California Code of Regulations, Title 8 – Industrial Relations, or Labor
- California Code of Regulations, Title 24, also known as the California Building Standards Code
- California Division of the State Architect 2009 California Access Compliance Reference Manual
- CPUC: California Public Utilities Commission

- SCRRA Engineering Standards
- Peninsula Corridor Joint Powers Board (PCJPB) Design Standards
- Local Building, Planning and Zoning Codes
- 49 CFR 200 Series: FRA Railroad Safety Regulations
- American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual
- Technical Specifications for Interoperability for the Trans-European Transport Network.

The Technical Specifications for Interoperability (TSI) are a set of standards required of all railroad systems in the European Union. The TSI are defined and published by subject matter, described as "subsystems". The TSI that is primarily relevant to this technical memorandum is that for the Infrastructure Subsystem, current version dated 19 March 2008 based on a Commission Decision of 20 December 2007. The Infrastructure TSI does not directly address station program requirements.

2.3 POLICY CONSIDERATIONS

Policy considerations can significantly influence the size of high-speed train stations as well as how they function. In developing this document, design assumptions were made that will require confirmation based on Authority policy. Potential approaches to addressing these issues are summarized in the following sections. Each policy assumption is cited below and liable to change.

2.3.1 Fare Control

Fare control may be pursued in several ways:

1. Proof-of-payment: No physical barrier is established between the "free" and "paid" zones. Patrons in a "paid" zone without a ticket are subject to fine.
2. Fare gates: Fare gate arrays separate the "free" and the "paid" station areas. Passengers must insert, slide or scan their ticket to gain passage through the fare gate.
3. Human ticket control: Patrons are required to present tickets for inspection in order to enter the "paid" area.

For the purpose of this document, it is assumed that fare gates will be used for fare control. Station facilities will be designed with barriers and fare gates separating a Free and Paid Area. In the event that a different system of fare control is adopted, the fare barrier will not be installed and the design will be sufficiently flexible to allow for other control methods.

The areas where a paid ticket is required for admittance and how this area is controlled must be determined. There are several options for establishing the "free/paid" line:

- Inside of the station: A ticket is required to enter areas of the station leading to the platforms. Some support areas may be necessary on each side of the barrier, such as waiting areas and restrooms.
- Entrance to platform: All areas of the station are open to the public with the exception of the platforms.
- Boarding train: All areas of the station are open to the public including the platforms. Ticketing facilities could be located along the platforms. A "free/paid" line upon boarding the train could prevent duplication of some patron support services but could result in platform congestion due to the presence of "meeters and greeters" on the platform.
- On the train: Passengers would be permitted to board the train with or without a ticket and purchase one from a conductor on-board.

For the purpose of this document, it is assumed that passengers will be required to obtain valid tickets and pass through the Paid Area prior to accessing the platform.

2.3.2 Ticket Purchase and Distribution

The number and type of ticketing transactions will influence station space requirements. There are three main ways that tickets could be purchased:

- Ticket sales office: A person-to-person interaction. Space is required for the ticket office, queuing space and supporting administrative space for the ticketing attendants. A ticket office may provide services in addition to ticketing such as information and security.
- Ticket vending machine (TVM): Tickets are purchased at the station using a machine. Space is needed for machine, corresponding queue and machine maintenance.
- Pre-purchase: Tickets may be bought online or by phone prior to arrival at the station. Patrons receive tickets prior to travel or obtain them via 'will call' at a ticket booth or a TVM.

All three options are assumed to be available and in use for the high-speed train system. However, one particular ticketing method may be promoted over others by providing more or less of one type of ticket purchasing facility. For example, many ticket booths and few TVMs would encourage more in-person ticketing. If the majority of tickets are to be purchased and received prior to arrival at the station, ticketing facilities at the stations may be reduced.

2.3.3 Baggage Handling

Baggage handling facilities require significant area to accommodate the movement of baggage between the ticketing area, the baggage "make-up" area, and trains; and from the trains to disembarking passengers. Facilities may be manual, automated, or a combination of methods depending upon the distance and quantity of baggage to be accommodated. Baggage handling facilities, if provided, need to be sized for the following activities:

- Receipt and checking of outbound baggage
- Receipt of inbound baggage from the train and dispensing these items to passengers (baggage claim)
- Storage of unclaimed and connecting baggage
- Storage of baggage tractors and carts
- Storage of cleaning and maintenance supplies

In most operating high-speed train systems, passengers carry and store their own luggage in luggage racks (of varying sizes) that are provided on the trains. In some systems, porters and luggage carts are provided to assist with luggage movement. For the purpose of this document, it is assumed that CHST will not have baggage handling capabilities. Passengers will board the train with their luggage. Stations may have luggage storage facilities for users to temporarily leave belongings at a station. These may consist of a staffed luggage check room and/or storage lockers.

2.3.4 Concessions

The level of commercial and privately operated services provided at a station could vary widely from a vending machine to extensive shopping malls and influence the design of "free areas", "paid areas", or potentially both. Commercial services for station patrons may include food (ranging from a coffee cart to full-service restaurants), travel services (such as rental car agency offices, travel agencies, or visitor bureau offices), ATMs or banks, and postal services. The Authority's *Adopted HST Station Development Policies* (May 14, 2008) (http://www.cahighspeedrail.ca.gov/highspeedtrain_stationdev_policies.aspx) encourage a high density of population, jobs, commercial activities, entertainment and other activities around stations which will influence the facilities provided in and around stations. As concessions are not a requirement for high-speed train operations, this technical memorandum only provides general space assumptions in order to not preclude basic passenger amenity services. Guidelines are provided for the interaction of concessionary space with required station spaces in Section 3.3.5.

2.3.5 Platform Edge Doors

In addition to platform safety rails and platform edge markings, platform edge doors may be provided if they are deemed necessary to protect passengers, particularly from trains passing platforms at high speed. Doors can serve multiple purposes, including accident reduction - especially where high-speed trains will operate non-stop through the station - for skip stop service, platform climate control, and improved security by limiting access to tracks. Platform doors are most common in subways and airport transit systems but fairly uncommon in train stations. Options for platform doors include:

- Platform screen doors. Full height barriers between the station floor and ceiling.
- Platform edge doors. Full height but do not reach the ceiling.
- Platform safety gates or platform gate doors. Gates are approximately 3 feet high and are used at some Shinkansen stations in Japan.
- Platform safety rails. No gates but safety railings between boarding areas.
- No doors. Only signage and tactile warning strip at edge of platform. This will decrease maintenance and operating costs.

For the purpose of this document, it is assumed that platform edge doors are not implemented in stations.

Should physical, operational, or budgetary constraints result in a condition at a station where tracks adjacent to a platform may be used by high-speed, non-stop trains, then the platforms may need to be equipped with appropriate equipment and infrastructure to ensure safety by keeping passengers away from the platform edge when a non-stop train is passing through. The solution at these locations could entail platform doors or barriers, visual and/or audible warning systems, and/or operational procedures such as restrictions on passenger access to platforms except when boarding of stopping trains.

The types of train movements occurring at each station will be driven by the operating plan, which will be developed and refined as planning and design progresses. Station planners and designers should keep apprised of the current operating plans for the Phase 1 and Full Build conditions, to understand the operating requirements at specific stations.

2.3.6 Sustainability

Station design and programming standards require sustainability measures to be implemented including obtaining a certain level of LEED certification (Certified, Silver, Gold or Platinum). The State of California Executive Order S-20-04 (14 December 2004, available at http://www.energy.ca.gov/greenbuilding/documents/executive_order_s-20-04.html) outlined a state-wide approach to Green Buildings through conservation and energy efficiency. The Executive Order required “that state agencies, departments, and other entities under the direct executive authority of the Governor cooperate in taking measures to reduce grid-based energy purchases for state-owned buildings…[which] include but [are] not limited to: …designing, constructing and operating all new and renovated state-owned facilities paid for with state funds as ‘LEED Silver’ or higher certified buildings…” As such, this document establishes that stations and station sites shall be, at minimum, LEED™ Silver Certified.

2.3.7 Environmental Control Systems (ECS)

Heating, cooling and ventilation make up the environmental control systems that could be implemented at HST stations. The use of these systems could be restricted to certain station areas or they could be used throughout stations. As the HST will pass through a wide range of climatic zones, the decisions to provide ECS could vary by station. Significant space and equipment are required for the operation of environmental control systems.

For the purpose of this document, it is assumed that all HST stations concourses and staff spaces will be environmentally controlled. Platforms, with the exception of underground stations,

will be open air with no heating or cooling. Auxiliary spaces will have environmental control as required by the room purpose and equipment.

2.3.8 Public Restrooms

The provision of restrooms in HST stations could be one of multiple scenarios:

- No public restrooms
- Public restrooms within the Paid Area for paying customers only
- Public restrooms within the Free Area, usable by the general public with access controlled by station staff
- Public restrooms within both the Paid and Free Areas and for any people at the station including those arriving, leaving, or meeting passengers.

Staff restrooms are required by code.

For the purpose of this document, it is assumed that restrooms will be provided in the Free, Paid and staff areas at terminal stations. Restrooms will be provided in the Free and staff areas at intermediate stations with public access controlled by station staff. Staff may use the restrooms in the Free Area at some intermediate stations.

2.3.9 Sharing of Facilities with Other Rail Operators

Some cities that will be served by the CHST system are also served by other intercity and/or commuter rail operators, including Caltrain, Metrolink and the Amtrak Capitol Corridor, San Joaquin and Pacific Surfliner services. Though the system will develop new station facilities, the stations may be located adjacent to or serve as extensions of existing stations at some locations.

The CHST system is expected to be well-connected to the existing passenger rail services. Ridership forecasts include assumptions about passengers transferring between high-speed trains and other train services. The passenger experience at stations should be convenient. Pedestrian transfer connections from train to train should be intuitive, short and direct.

Station requirements are based on the assumption that high-speed trains utilize dedicated platforms at stations and have a dedicated paid area within which access can be limited to ticketed high-speed train passengers, and which can be protected by a fare control array and security screening cordon, if such facilities are deemed appropriate.

The differentiation of free concourse facilities is less clear-cut. Stations could have a single free concourse providing access to platforms used by multiple rail operators, or it may be more practical to provide free concourse areas for each operator, interconnected by pedestrian walkways.

There may be significant benefits to integrating or co-locating facilities for the various rail operators, including operating cost savings, ease of passenger transfers between services, and improved customer orientation and convenience. The opportunities and possible physical configurations depend upon the relative orientation and location of the tracks and platforms used by the different rail operators, such as side-by-side tracks and platforms, and different vertical levels for the high-speed and other trains.

For purposes of this document and station planning, stations will be planned as stand-alone facilities providing sufficient space and facilities to accommodate the requirements of high-speed train patrons. As design progresses, opportunities can be explored for sharing some functions and facilities among rail operators at stations that will be served by more than one operator. Examples of possible shared functions include ticketing, information dissemination, security, cleaning, and facility maintenance.

In any case, CHST stations either directly or indirectly connected to other rail systems will be planned in conformance with CHST design standards and criteria; neighboring rail systems shall be requested to adapt their design standards to coexist with and complement CHST design standards. In instances where design standards (fire and life safety, security, station access,

accessibility, etc.) of the two or more rail systems conflict the more stringent standard shall be adopted. Project designers shall identify areas of conflicting standards needing reconciliation.

2.3.10 Bicycle Access

Some rail services in California permit passengers to carry bicycles directly on-board trains, either on a reserved, unreserved or first-come, first-served basis. Other rail services permit bicycles to be boxed and carried aboard as hand luggage. The policy that is established with respect to passengers carrying bicycles on-board trains will influence the circulation, access, and temporary storage facilities that will be needed at stations.

Design of the platforms, vertical circulation elements and passenger circulation, waiting and queuing areas will take into account requirements for passengers with bicycles.

For the purpose of this document, it is assumed bicycles are allowed on-board certain cars.

2.3.11 Small Package Express Service

High-speed trains may prove to be a convenient, timely and reliable way of delivering small packages (unaccompanied by passengers) between cities served by the CHST system – and might prove to be profitable for the system operator. Should a decision be made to provide such a service, facilities will need to be provided at stations for the receipt, collection and processing of these packages. The capability of handling such packages would need to be built into the design of the high-speed trainset. Special equipment would facilitate station operations, such as carts with storage containers for these packages, and operating procedures would need to be crafted to ensure that the off-loading and loading of these small package containers could occur without lengthening train dwell times. Alternatively, a small package service could utilize dedicated trains and loading, unloading and distribution facilities.

Station designs will be sufficiently flexible to accommodate the future introduction of such service, should it prove to be workable. If small package express service is provided, system requirements will need to be defined.

3.0 ASSESSMENT / ANALYSIS

3.1 STATION DESIGN CONSIDERATIONS

Design standards and guidelines for international high-speed train systems were reviewed along with Caltrain, Metrolink, and Amtrak criteria. Several stations will be served by both high-speed trains and conventional passenger trains making these standards and guidelines important. It is recognized that there will be a high degree of variability between stations due to different station locations, ridership demands, potential intermodal connections, different trip purposes, and, at existing stations, due to local land use and building codes. The following sections identify design elements to be considered at high-speed train stations. The design guidelines are considered to be a minimum standard; local and unique circumstances will be considered in each station's design.

This document provides guidance on high-speed train passenger station elements and requirements in order to develop station plans to the 30% Design level. Future design guidance will be developed to inform post-30% Design. Topics that are currently not considered but will be in future guidance include:

- Platform edges and ends
- Finish materials
- Security devices and alarms
- Security monitoring
- Signage and graphics
- Information monitors
- Advertising
- Emergency egress for the disabled

3.1.1 General Considerations

These considerations are intended to assist designers in the configuration of spaces within the station envelope. Major stations' areas and facilities are described. Design and sizing of stations will consider:

- **Safety.** Safety of station patrons, train passengers, and operating personnel shall be the first priority in station design.
- **Station Size.** Stations shall provide adequate space for all essential station functions including platforms, public circulation, passenger services, station operation offices, core systems and plant rooms, and special provisions at terminal stations.
- **Design Life.** The Design Life for passenger stations is addressed in TM 1.1.2 Design Life.
- **Shared Use.** Shared-use stations require that station design serves both high-speed and conventional rail services. Shared use does not infer shared functions; at stations where multiple rail systems are sharing an enclosure, functional, operational, and support facilities for HST are dedicated and not shared with other operators.
- **Clarity.** Stations shall be organized clearly and simply. Circulation routes shall be clear and unobstructed.
- **Future Expansion.** Station design shall consider and plan for future extension and expansion as well as ridership growth where feasible. This may include increase in system reach, increase in train arrival and departure frequencies, and increase in station passenger handling capacity including emergency exiting capacity.
- **Future Modifications.** Stations design shall consider a "not to preclude" approach and provide sufficient flexibility to accommodate future updates to the programmatic requirements, within reason.
- **Context.** Each station shall be responsive to its unique physical environment and context.

- **Finish materials.** Stations shall utilize finish materials that are durable, energy efficient, and easy to maintain.

3.1.2 Architectural Principles

3.1.2.1 General

While the majority of this Technical Memorandum sets forth planning guidelines and technical requirements for CHST stations to implement, this section is intended to convey the more subjective and esoteric qualities and aspirations of station architecture. The architectural design philosophy and principles are provided to assist designers in developing station design solutions that achieve the objectives of the Authority. Architectural treatment of support facilities, maintenance depots, guideways and other ancillary facilities will be addressed in a separate document.

The Authority's Station Development policies (May 14, 2008) state that the "success of HST is highly dependent on land use patterns that….encourage high-density development in and around the HST station" and "HST stations, by their nature will be the most effective and powerful tool to create the market conditions that attract basic sector jobs to the station areas." Design excellence of CHSTP stations and facilities will attract customers and reflect the policies of the Authority.

3.1.2.2 California State Excellence Goals

The CHSTP supports the broad goals set forth by the California Department of General Services (DGS) "Excellence in Public Buildings" (EIPB) program which promotes "high-performing public buildings and a positive architectural legacy that reflects the State's commitment to excellence." (http://www.documents.dgs.ca.gov/dsa/pubs/eipb.pdf) This statement communicates the State's expectations in the building delivery process. The program seeks to produce high performing public buildings through "Excellence Goals", establishing objectives that promote design excellence, sustainability, enduring value and public benefit.

The Authority supports the state's "Excellence Goals" as a basic foundation by which the design of high-speed train stations shall be measured.

1. Architectural Excellence – Attract outstanding architects who are committed to design excellence, best practices in energy and environmental sustainability and the other goals of EIPB.
2. Sustainability - In accordance with Executive Order S-20-04, LEED certification of Silver or higher shall be provided.
3. Integrating Art into Public Buildings and Spaces – Expand the public experience with art while adding to the building's identity and enhancing the human experience.
4. Cost Effectiveness – Use performance standards, life-cycle costing, and integrated design to deliver value above the initial financial investments.
5. Universal Design – Enhance accessibility for all.
6. Safety and Security – Safe and secure from natural or man-made disasters.
7. Make a Positive Contribution to the Local Community – Buildings sited and designed to enhance the local built environment. This goal includes:
    - involving community participation
    - strengthening and revitalizing California's cities and communities
    - enhancing the livability of the community
    - supporting economic renewal
    - encouraging multiple uses of public spaces
    - promoting use of public transportation

- supporting sound growth patterns
- providing convenient access for customers and employees
- reducing traffic congestion, and
- promoting improved air quality.

8. Preservation of Buildings of Historic Value – Preservation of historic buildings retains the art of architecture that has contributed to the community for decades.

3.1.2.3 System Design Philosophy

The central objective for design of the CHST system is to provide a safe, convenient, fast and efficient means of travel to the users. A secondary fundamental design principle is to present a strong, positive image of the CHSTP facilities to the citizens of California through excellent architectural design.

Given the State of California's aforementioned design excellence principles as overarching guidance, the architectural image of CHSTP stations and facilities will be of particular importance. As perhaps the nation's first high-speed rail system, the CHSTP will establish a standard of quality for many similar systems to follow. The nation and the world will be closely watching the CHSTP's architectural approach to station design and the utmost attention must be taken in producing architecture commensurate with the greatness of the State of California.

CHST stations will symbolize a new mode of travel and transportation for this nation, not unlike the great urban railway stations that have become the heart of communities throughout the world. Convenient interchange with other modes of transportation will be the catalyst in creation of successful transportation centers and development of communities into which they are to be built.

The high-speed train system will present unique challenges and architectural opportunities. High-speed rail has existed for decades in other parts of the world, but the system will present a new kind of silhouette upon California's architectural landscape; uncommonly long station buildings and frequent movement of trains will introduce an unfamiliar yet exciting visual experience. While each CHST station will be expected to integrate the functional and safety requirements within the constraints of budget and schedule, each will be expected to convey a strong individual civic character, relating clearly and strongly to its context through careful architectural design.

3.1.2.4 Architectural Station Design Principles

Uniqueness: Because each community to be served by a HST station is unique, architectural design of each station will be unique. The specific functional needs of each station will be wrapped with an architectural skin which is site-specific in scale, massing, volume and material. Although certain internal and functional elements of station design will be common to all stations, the high-speed rail station image to be presented to each community will be a carefully considered response to the context of each station site.

Design Factors: Specific purpose, context, presence and image must be defined individually for each station. Each station must respond to unique, site-specific design factors including location, alignment, existing and future neighborhood architectural and historic context, anticipated ridership, climatic variations, vehicular and pedestrian station access, multi-modal transfer, protection from the elements, passenger orientation and familiarity, wayfinding, constructability and sustainability.

Community Links: As a new focal point of the community, the planning and siting of the HST station must convey an awareness of its prominent presence. It will not seek to dominate its neighborhood but rather to be sensitive to its community and context. Connections, entrances and station access points will respond to neighboring residential, commercial or other uses.

Massing: Vertical location of platforms, concourses and entrances will be a significant factor in the massing of each station; at-grade stations with an adjacent at-grade concourse will convey a significantly different presence within an urban context than will an elevated station raised sixty or more feet above the street. This kind of inherent programmatic difference will be a driving influence in the presence of a station and in the architectural solution.

Style: Stylistic trends in early twenty-first century architecture will not remain constant; therefore while each station must reflect current and forward-thinking innovation, it must avoid a design approach which may appear dated decades later. Station context and community concerns must be reflected in station design. Where CHST stations are to be located in established urban environments, the goal will be to transform and enhance that environment and community while protecting the neighborhood's fabric. Where CHST station sites are to be located in sites without a strong existing character or context, the goal will be to establish a strong architectural foundation for future community growth.

Image: Railway stations are a unique building type with a unique purpose. The image of a CHST station will therefore convey the function of the building through its architectural design. A railway station should look like a railway station. As gateways to the CHST system and to major metropolitan centers, stations will convey an arresting image.

Context: Care will be taken to be sensitive to the station context, recognizing that an architectural solution appropriate for a densely populated, established urban center may not be appropriate for a smaller suburban community. In many cases, subtlety and understatement may be more appropriate than exhilaration and innovation.

Local Emphasis: While every station will satisfy the functional planning criteria as stated throughout this document, architectural treatment and approach will vary commensurate with the degree of local participation. Every station will be expected to satisfy the overarching goals of design excellence while recognizing the importance of local context. At a minimum, functional stations will be enclosed in a unique but architecturally reserved skin, conveying architectural subtlety while featuring striking interior spaces. Local jurisdictions wanting their HST station to make a more dynamic and impactful "architectural statement" may choose to partner with the Authority in developing "iconic" station architecture, characterized by a sense of prominence on the site, architectural expressiveness, exhilarating passenger experience, organic or curvilinear forms, unique detailing and/or uncommonly rich finish materials.

Finish Materials: Exterior materials selected for stations will be for the specific site context while satisfying system-wide design concerns including safety, useful life, durability, low maintenance, replacement and potential vandalism. Materials will respond to the context of the site and convey stability, warmth, brightness and quality.

Lighting: The presence of a high-speed rail station at night is no less important than during daylight hours. Prudent and dynamic use of lighting will be a significant design element in a station's nighttime presence. Station interior lighting will designed to create an inviting station presence when viewed from the exterior, while ensuring energy efficiency and satisfying sustainable design goals. Station sites, including parking, approaches, landscaping, signage and entrances must be appropriately lighted for user safety as well as for architectural effect.

3.1.2.5 Interior Station Design Principles

Station Volume: The greatness of railway stations in times past has often centered upon soaring station volumes. Similarly, upon entering a CHST station, the patron will experience a sense of exhilaration, spaciousness, openness, clarity and system identity. Entrances and concourse spaces will be generously and appropriately sized according to the specific functional needs of each station. At the same time, a striking architectural image will be established through the judicious use of vertical space and interior volume. Ceiling heights may be modulated wherever the opportunity exists. Low ceilings will be used sparingly as an intimate contrast to the vertical volumes.

Openness: Station planning and design will be founded upon uncomplicated and open concepts to facilitate free movement of passengers and staff. Adherence to principles of passenger circulation described in the following sections, particularly with respect to clear, unobstructed, well-defined, well-lighted routes for public circulation are essential to planning of public areas and passenger satisfaction.

Interior Lighting: Liberal use of natural lighting is a guiding principle for station interiors. Natural light creates drama within interior spaces as it changes constantly throughout the day. Openings which allow light into the station during the day contribute to a more dynamic station presence

within the community at night. Artificial interior lighting will be used judiciously to illuminate the functions requiring task and safety lighting and differentiating between differing station functions. Light sources and placement must be attentive to the energy standards established by the State of California.

3.1.3 Functional Consistency and Variability

Elements of station design can be categorized into two classifications: functionally consistent elements and functionally variable elements. Functionally consistent elements can lead to reduced capital, operations, and maintenance costs through reduced design and construction variation, economies of scale, and simplification of operations and maintenance procedures. However, unique and recognizable stations will improve the passenger experience and encourage fulfillment of the Authority's *Adopted HST Station Development Policies*.

Functionally consistent elements include but are not limited to:

- Signage and graphics
- Passenger Information Systems
- Ticket Sales Office location and identity
- Fare collection and train boarding process
- Escalators and elevators
- Fare collection equipment
- Communications systems
- Platform minimum width and length, as addressed in the TM 2.2.4 Station Platform Geometric Design
- Station Information Office
- Platform Agent Booth
- Platform floor finish surface and edge material
- Door hardware
- Public Area lighting fixtures
- Non-public area staff and plant rooms

One key to accomplishing the functional consistency of station facilities will be the development of station-operating and passenger-handling procedures. These procedures will be developed as the planning and design process progresses.

Functionally variable elements include:

- Site layout and furniture
- Freestanding entrances, where applicable
- Concourse configuration
- Finish materials in accordance with the Project's acceptable palette
- Interior seating
- Artwork

3.1.4 Passenger Accommodation

3.1.4.1 Public Areas

Public station areas intended for passenger circulation shall accommodate forecast ridership for the Full Build (2035) or projected Phase I, whichever is higher under estimated peak period and emergency conditions.

3.1.4.2 Boardings

- Boardings are indicated using a subscript "B" (P_B).
- **Daily Boardings:** Design shall be based on the peak day boarding as provided in TM 4.2 Train Service Plan – Phase 1. The peak day boardings take into account seasonal and day-of-week peaking as well as possible changes in HST level of service which may impact station passenger demand.
- **Peak Hour Boardings (P_{60B}):** Ridership peaking factors to convert peak day boardings to peak hour boardings are provided in TM 4.2 Train Service Plan – Phase 1.
- **Peak 30-minute Boardings (P_{30B}):** Half of all the peak hour boardings, multiplied by a system surge factor of 1.2.
- **Peak 15-minute Boardings (P_{15B}):** A quarter of the peak hour boardings, multiplied by a system surge factor of 1.3**.**
- **Peak minute Boardings (P_{1B}):** Peak hour boardings divided by 60 and multiplied by a system surge factor of 1.5.

Table 3-1: Peak Period Boardings

Symbol	Description	Formula
P_{60B}	Peak Hour Boardings	Peak day boardings x Peaking Factor
P_{30B}	Peak 30 minute Boardings	(P_{60B} ÷ 2) x 1.2
P_{15B}	Peak 15 minute Boardings	(P_{60B} ÷ 4) x 1.3
P_{1B}	Peak Minute Boardings	(P_{60B} ÷ 60) x 1.5

3.1.4.3 Alightings

The variables in Section 3.1.4.2 only apply to passengers boarding the trains. Alightings are shown using a subscript "A" (P_A). Peak alightings (P_{60A}, P_{30A}, P_{15A}, P_{1A}) are assumed to be equal to peak boardings.

3.1.4.4 Other Station Users

It is expected that some high-speed train passengers will be dropped off or picked up at the station. The number of people who drop-off or meet HST passengers is estimated to be one-tenth of the total peak boardings and alightings. Total station occupancy also includes station staff which varies based on operating conditions and station type.

3.1.4.5 Maximum Trainloads

High-speed trainsets will accommodate between 900 and 1000 passengers. Terminal station platforms shall be sized to accommodate surge loads. Intermediate station platforms shall safely accommodate and evacuate one full trainload of passengers at each platform edge in the event of a mechanical failure or emergency condition.

3.1.4.6 Delayed Trains

Station facilities will need to accommodate the additional passengers that will accumulate within the station when a train is cancelled or seriously delayed. Estimates will be developed for

expected concentrations of passengers that will accumulate within station facilities under various delay and service disruption scenarios. The methodology to be used to analyze passenger movement and potential delay conditions will be developed as the planning process progresses in a separate document.

3.1.5 Station Vertical Configuration

Stations can be identified according to vertical platform location, as follows:

- *Underground Stations.* Platforms are located below grade and completely enclosed.
- *At-grade Stations.* Platforms are located at-grade, typically open to the air.
- *Elevated Stations*. Platforms are supported on a superstructure above grade or passing over surface features.

3.1.6 Station Functional Types

Station functional types will influence station planning and design significantly. The most significant of these types are outlined in the following sections.

3.1.6.1 Intermediate Stations

Station design must acknowledge the operating conditions at intermediate stations since most trains will have short dwell times. Passengers will typically need to be on the platform prior to the train's arrival. In the event that boarding passengers are assigned to specific seats or cars, they will need to be provided with information about where to wait at the platform, so that they can quickly board the proper car when the train arrives. The platform will encourage distribution of passengers along its length and be a comfortable environment for passengers awaiting trains.

Sufficient platform area must be provided to allow alighting passengers to exit the train without being obstructed by boarding passengers – and without causing boarding passengers to crowd near the platform edge.

3.1.6.2 Terminal Stations

Trains will occupy terminal station platforms for longer periods of time than will be the case at intermediate stations. Terminal stations are expected to be provided with additional ancillary facilities to prepare the trains for a return trip in the opposite direction. Activities occurring on or utilizing terminal station platforms may include re-stocking and provisioning the on-board food service facility, light interior cleaning of the train and trash removal, train crew circulation to and from the train, and mechanical inspection of the train between trips. Requirements for lay-up and overnight storage at stations are defined in TM 5.1 Rolling Stock Maintenance Plan and Facility Requirements.

Requirements for passenger-handling will depend upon layover time, a function of the system operating plan. When layover times are sufficiently long, passenger boarding will begin only once all alighting passengers have exited the arriving train and the train has been cleaned, inspected, serviced and provisioned. Departing passengers may be held within the concourse areas until a predetermined time in advance of the boarding process.

There may be instances at a terminal station when arriving trains will need to make a relatively rapid departure. In these cases, it may be desirable or necessary to allow the boarding passengers to occupy the platform prior to an incoming train's arrival, in which case the platform will need to have sufficient area to accommodate the boarding and alighting passenger loads simultaneously without creating undue congestion or hazardous conditions.

3.1.6.3 Intermediate Stations with Turnback Service

Operating plans are under development that will indicate the need for selected trains to originate and terminate at intermediate stations along the route – to balance the supply and demand for rail system service and capacity and to ensure effective utilization of the high-speed train fleet. These stations also may require some of the elements of a terminal station, such as spaces for train crews to wait and rest, even if relatively few trains turn there. Each of the locations in this category will need to be considered individually.

3.1.7 Sustainability and LEED

Stations shall be, at minimum, LEED™ Silver Certified. LEED certification evaluates buildings across the following categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation in design, and regional priority. Sustainability practices applicable to rail stations and facilities are discussed in the APTA Transit Sustainability Practice Compendium including materials, energy, ambient environment and health, and emissions and pollution reduction.

3.1.8 Emergency Access

In accordance with NFPA 130, the local emergency authorities will respond to a station emergency according to a pre-approved emergency plan. Emergencies may include a fire within the station public or non-public areas, a train collision or derailment, loss of station or traction power, necessity to evacuate passengers, disabled or stalled train at a platform, natural disaster, presence of hazardous materials, passenger need for first aid, earthquake or other emergency.

In the event of an emergency, the local first-responder will be summoned and will require access into any or all areas in or around the station. At least one entrance will be designated as the emergency entrance. Station design shall incorporate provisions as required by the state fire marshal and local fire jurisdiction to allow firefighter access to any and all portions of the station, i.e., dedicated firefighters' entrances, stairs or other. Station plans shall demonstrate acceptable strategies for emergency access as well as emergency evacuation.

3.2 STATION PLANNING AND PASSENGER MOVEMENT

Station planning includes determination of required capacities, floor areas, adjacencies of uses and functional connections between spaces. This section describes the types of spaces required in CHST stations, corresponding areas for those spaces, basic functions, characteristics, and interrelationships of those areas. These standards and guidelines reflect only the needs of CHST, not those of any adjacent transportation facilities or systems.

Major station spaces include but are not limited to: station entrances, free area, commercial areas, free/paid line, paid area, platforms, passenger service areas, station operation offices, core system spaces and building plant spaces.

3.2.1 Goals

The main goals in planning station spaces are as follows:

- Safety and security of passengers and station occupants
- Avoidance of passenger congestion and compliance with level of service objectives
- Flexibility to accommodate surges in demand or disruptions in train service
- Adequate emergency evacuation capacity and compliance with emergency procedures
- Simplified flow between origins and destinations within station and surrounding areas
- Provide unobstructed lines of sight and well-lit spaces
- Accessibility for disabled passengers
- Flexibility to accommodate increases in passenger demand, and changes in facilities and operating procedures
- Accommodate and encourage efficient and convenient interchange with other modes of transportation.

3.2.2 Station Size

General. Every station is comprised of public and non-public functions and shall be planned individually to accommodate the functional needs for the specific location. Basic station components include:

1. Platforms (size is a function of train length, vertical circulation and passenger circulation)
2. Public Concourse (size is a function of ridership)
3. Support Space (size is a function of staffing levels)
4. Systems and Plant Rooms (size is a function of systems equipment and plant rooms)

Platforms. Platforms are the key components for public access to trains. Platform size is a function of train length and width of escalators, stairs and passenger circulation and will generally be unaffected by ridership. Size shall be sufficient for safe circulation of passengers on platforms during normal and emergency conditions.

Public Concourse. Public station areas within the concourse and mezzanine intended for passenger circulation shall accommodate forecast ridership in the Full Build (2035) or projected Phase I, whichever is higher under estimated peak period and emergency conditions. Sizing of the public concourse and related facilities shall consider the appropriate peak period within the daily peak as specified in section 3.3 and detailed in section 3.1.4. Public spaces include concourse paid and free areas, passageways and vertical circulation elements.

Non-public Areas. Non-public station areas comprise the majority of concourse space and are generally unaffected by forecast ridership; space required for these uses is determined by operational and technical needs. Non-public areas include passenger services, operations, core systems rooms, plant rooms and terminal facilities where they occur.

Terminals. Terminal stations shall be planned in accordance with the goals, facilities and functional needs of intermediate stations while also providing space to accommodate terminal functions. Specific terminal space requirements are described in section 3.6.5 and throughout this document. Additional platforms may be required to accommodate terminal train operation needs. The special operational conditions of terminals will generally result in a larger station than the intermediate type.

Station Sites. Site conditions will influence station planning and size. Each individual site will influence placement and number of exterior entrances and organization of interior spaces. Placement of intermodal transportation connections will depend on availability of adjacent site area and optimum placement in relation to entrances. Where site conditions and passenger use warrant entrances on two sides of the trackway, dual entrances may be considered.

3.2.3 Public Zones and Passenger Flows

In order to simplify station planning and passenger movement, stations are divided into functional zones. Passenger flow through these zones is as follows:

- Passengers pass through a station entrance and into the concourse/ticket hall where information, ticketing, and basic services are easily identified and located.
- Upon obtaining tickets and current train information, departing passengers will either proceed to a waiting area or make use of station amenities within the concourse. Depending upon the station configuration and passenger-handling procedures that are being employed, departing passengers may use dedicated waiting space within the free concourse area or proceed to the paid area.
- Before the train's expected departure time, passengers will be instructed by announcements and dynamic signage to proceed to the appropriate platform (and to a specific area of the platform if the system employs reserved seats or cars) to prepare for boarding the train. If reserved seats or cars are not used, passengers will be informed about the availability of seats in each car prior to train arrival.
- When the train arrives, the arriving passengers alight, and then the departing passengers board the train.
- Arriving passengers move from the platform, through the paid concourse to the free concourse, and to the station exit. Services within the free concourse for these arriving passengers include travel and transportation information and services, and "meeting and greeting" space. At high volume stations which have short headways, segregation of

arriving and boarding passenger flows will be considered in order to minimize congestion and passenger confusion.

3.2.3.1 Level of Service

The primary performance measure that will be used to determine the adequacy of pedestrian circulation facilities within the station will be peak Level of Service (LOS), as defined by Fruin[1], which describes the peak degree of congestion, based on density, at key locations within the station. This methodology is used throughout architecture, planning and engineering to size spaces for pedestrians and is not specific to types of facilities but instead general corridors, stairways and queues.

3.2.4 Station Vertical Organization

The two primary station areas in any station are the Platform and the Concourse. These areas are typically situated on different levels but may also be at the same level. The Platform provides waiting and circulation space adjacent to the trainway. The Concourse is situated between the platforms and the entrance/exits and provides space for waiting, fare collection processes, passenger circulation and station amenities. In some cases a Mezzanine may be planned as an intermediate level to connect the Concourse and Platform levels. Generally CHST stations will be planned on two or more levels with the Concourse closest to ground level.

3.2.5 Station Platform Configuration

Stations may be planned with either center or side platform configurations, depending on numerous interdisciplinary design and operations considerations. Most intermediate stations will be configured as side platforms. The following summarizes potential platform configurations.

Center Platform. This is the operating configuration in which the tracks run alongside either side of a single platform. Passengers utilize the same circulation elements to access either northbound or southbound trains.

Side Platform. Platforms are located along the perimeter of the station and a single track is positioned adjacent to each platform. Platform vertical circulation, amenities and staff spaces may be duplicated at each platform. Side platforms are preferable where both through tracks and stopping tracks serve the station.

3.3 CONCOURSE AND MEZZANINE

The concourse is the interior area between the station entrances and platforms, including the free area and paid area. This area is the gateway to the rail service and provides passengers with information, ticketing, and waiting areas for passengers and “meeters and greeters.” Where appropriate, a mezzanine level may provide an intermediate level on which some of these passenger and staff facilities are located. This section addresses public areas of the concourse. Non-public concourse areas are addressed in a following section.

3.3.1 Concourse Layout and Design

Openness. Concourses shall be open, spacious and have a high level of visibility to optimize passenger orientation and staff surveillance.

Obstructions. Passenger facilities such as public toilets, ticketing windows, information kiosks, and all associated queues shall be located clear of primary paths of pedestrian movement.

Primary paths of pedestrian movement shall be free of columns and other obstructions.

Ceiling Height. Suspended concourse ceilings shall be no less than 10 feet above the finished floor; a minimum of 16 feet is preferred. Clearance beneath signs or other obstacles shall be minimum 8 feet. A ceiling utility zone no less than 3 feet clear in height shall be provided between suspended ceilings and the structure above.

[1] Pedestrian Planning and Design. John J Fruin, Ph.D. 1987.

3.3.2 Free Area

General. The Free Area is the area in the concourse where patrons may circulate freely without a ticket and where space is provided for station entrances, passenger circulation, public restrooms, passenger information, and passenger ticketing. Intermediate stations will preferably provide a single free area in order to consolidate passenger amenities and staff functions within a single managed space. It will be located on the ground level adjacent to the entrances to facilitate passenger orientation upon entering the station. The space will immediately convey the dynamic image and identity of a CHST station.

Multiple Free Areas. At terminal stations and special intermediate stations where station access conditions necessitate separation of entrances and multiple free areas, free walkways will connect the concourse free areas. At stations with intermodal transfers, the location of other modes may make this infeasible and passenger ticketing and information services may have to be duplicated.

Non-HST Patron Circulation. Depending on the station site, the station may be used for site or neighborhood circulation. Where appropriate, the station free area will allow for circulation across the station and across station area tracks. This will enhance the importance of the free public space and integration of the station into station area development.

3.3.2.1 Entrances

General. Entrances provide a gateway between the station building, the station site, and the surrounding community. As such, they will be distinctively designed, clearly identifiable from either the station interior or exterior, and easily accessible. Entrances may be freestanding or integrated into surrounding development provided they are clearly identifiable as station entrances. For stations with more than one major entrance, one entrance will be designated as the main entrance and be provided with all required facilities. The other side of the station may be provided with minor amenities and ticketing provisions. A free passageway will connect secondary entrances to the primary entrance.

Location. Locate entrances wherever passengers may need to connect with other modes of transportation, e.g., adjacent to taxi drop-offs, bus drop-offs, kiss and ride, passenger parking, etc.

Number. Because entrances are also exits, the number and size of entrances must meet emergency exiting requirements. Entrances may be supplemented with emergency exit doors to provide the required exiting capacity. Stations shall have at least two entrances.

Sizing. The minimum width of each entrance is 10 feet. At least one entrance shall have a width of 15 feet. Floors directly adjacent to entrances shall be level for at least 10 feet inside and outside of the entrance. For rail passengers, especially those carrying luggage, automated sliding or swinging doors are preferable to revolving doors and provide a higher capacity for passenger flow. Large diameter revolving doors may be used. Doors shall have a minimum width of 3 feet. A minimum clear space of 2 feet shall be provided to each side of a door or group of doors. Each entrance shall have a minimum width of one half of the required egress width for the station.

Other Considerations. Entrances must be ADA accessible. Exterior entrances shall provide wind, rain and flood protection if required in the area. Vestibules will be considered where station temperatures will be dramatically different than exterior temperatures. Entrances must be provided with rolling shutters or security gates to allow for station closure.

3.3.2.2 Concourse Free Area Circulation

General. The concourse free area contains circulation space for passengers travelling between station entrances and the paid area. Primary routes of passenger movement within the free area will connect all primary entrances with one another without obstruction. Ticket sales, passenger information, public toilets, and waiting areas shall be located adjacent to main circulation paths and will be clearly visible to passengers. Passenger information within the free area includes system signage, passenger information system displays (including a prominent timetable screen displaying train arrivals and departures), and a large-scale clock.

Location. Concourse circulation will typically be located on the ground level adjacent to entrances for clarity of function for passengers entering the station.

Configuration. Wherever possible, avoid turnbacks and U-turns as passengers circulate between entrances, ticketing facilities and the fare collection line. Avoid cross flows between boarding and alighting passengers.

Sizing. Adequate width shall be provided for unobstructed horizontal circulation between entrances and the concourse paid area. Circulation width is based on peak hour passenger boardings and alightings. Net free area circulation width, C_f, exclusive of any obstructions, is calculated as shown in Table 3-2.

This circulation width shall be exclusive of other required spaces such as waiting areas, information kiosks or queues for ticket purchases. Where the primary circulation route bifurcates towards multiple exits the minimum width may be proportionate to the estimated entrance users. Circulation space configuration and size are determined by the arrangement of station entrances, passenger service facilities, fare collection and vertical circulation.

3.3.2.3 Free Waiting Areas

General. Free waiting areas provide a place for passengers and the general public to wait prior to entering the paid area or leaving the station.

Location. Waiting areas will be located so they are easily accessible but do not impede the principal circulation paths between entrances and the paid area. As some of this space is dedicated for “meeting and greeting” of passengers, locate waiting areas adjacent to primary circulation paths. Spaces will be organized so that those waiting do not impede flows for others going to and from the platforms. There may be single or multiple waiting areas within the free area. Queues for ticketing facilities may not encroach into waiting areas.

Amenities. Seating and provisions for visual display and audio announcement of train arrival and departure information shall be provided in waiting areas.

Sizing. Total area for waiting within the Free Area, W_f, shall be sized as shown in Table 3-2 (consistent with THSR Station Design Criteria).

3.3.2.4 Ticketing and Station Information

General. Ticketing and station information provisions are located within the concourse free area and will be directly visible to passengers entering the station.

Ticketing. Provide space within the free area for a Ticket Sales Office and Ticket Vending Machines. Queuing areas for ticketing functions shall not encroach into other required free area spaces. Space requirements and standards are discussed in Section 3.6.2 – Passenger Service Areas. Fare collection is addressed in Section 3.7 – Fare Collection.

Station Information. Provide a staffed Passenger Information Counter within the free area as described in Section 3.6.2.4. This counter and its queue shall be located adjacent to the primary circulation routes and shall not obstruct passenger circulation. Other unstaffed information kiosks, providing written information, maps, train schedules, etc. shall be located within waiting areas and near entrances.

3.3.3 Paid Area

Defined. The Paid Area is located between the fare collection line and the platforms. It includes concourse circulation space, waiting areas, paid public restrooms, mezzanine (where occurs) and vertical circulation elements leading to platforms. Within the paid area, passengers will be able to reach all platforms. Platforms are within the paid area but are addressed in Section 3.4 and in TM 2.2.4 – Station Platform Geometric Design.

Access. Access into the paid area requires a paid fare and possession of a valid ticket.

Demarcation. It is assumed that the demarcation between Free Area and Paid Area is located at the fare collection line which employs mechanical fare gates and reads valid tickets or other fare

media, but may change depending on the fare collection policy adopted. In addition to fare gates, provisional space for security measures should be included as defined in Section 3.7.4. As passengers enter the paid area, they will be able to immediately locate vertical circulation routes to the platform.

Amenities. Extensive signage and passenger information will be displayed throughout the paid area.

3.3.3.1 Concourse Paid Area Circulation

General. Direct movement between the fare collection line and platforms will be facilitated through clear sight lines and logical configuration. Connections to the platform may require vertical circulation including stairs, escalators, and elevators (Vertical Circulation is discussed in Section 3.5.3). Waiting areas and paid area restrooms will be located within the concourse paid area but will not impede major circulation routes. Avoid turn backs wherever possible, providing direct routes between the fare line and vertical circulation.

Sizing. Adequate width shall be provided for unobstructed horizontal circulation between the fare collection line and vertical circulation leading to platforms. Circulation width is based on peak hour passenger boardings and alightings. Net paid area circulation width, C_p, exclusive of any obstructions or other required spaces such as waiting areas, is calculated as shown in Table 3-2. The overall paid area circulation space is determined by the organization of the concourse free area circulation space and passenger service facilities relative to platforms.

3.3.3.2 Paid Waiting Areas

General. Paid waiting areas provide a place for passengers to wait prior to entering a platform. Short-term seating, information screens, and waste receptacles are located in this area.

Location. Waiting areas will be located so they are easily accessible but do not impede the principal circulation paths between the fare collection line and vertical circulation leading to platforms. Spaces will be organized so that those waiting do not impede flows for others going to and from the platforms. There may be single or multiple waiting areas within the concourse paid area. Additional waiting areas may be provided on platforms but will not impede platform circulation.

Amenities. Seating and provisions for visual display and audio announcement of train arrival and departure information shall be provided in waiting areas. Waiting areas will include power outlets for laptops, Wi-Fi and television monitors. Public wireless services need to be coordinated with the station communication system to prevent conflict. Views of arriving and departing trains will be provided where possible.

Sizing. Total area for waiting within the Paid Area, W_p, shall be sized as shown in Table 3-2 (consistent with THSR Station Design Criteria).

Table 3-2: Concourse Circulation Width and Waiting Area

Symbol	Description	Formula [1, 2]
C_f	Net Free Area circulation width	$(P_{15B} + P_{15A}) \div (15 \times 10$ people/ft/min$)$
C_p	Net Paid Area circulation width	$(P_{15B} + P_{15A}) \div (15 \times 10$ people/ft/min$)$
W_f	Net waiting area in Free Area	$[(P_{15B} \times 1.1) + (P_{15A} \times 0.1)] \times 14 ft^2$
W_p	Net waiting area in Paid Area	$P_{15B} \times 14\ ft^2$

[1] P_{15B} = Peak 15 minute boardings; P_{15A} = Peak 15 minute alightings

[2] at LOS B

3.3.3.3 Premium Club Lounge

General. Selected stations may include a premium club lounge to cater to business travelers and "frequent rider" customers. The facility would provide premium amenities – such as those found at airline clubs, airport business centers or Amtrak's ClubAcela.

Location. The premium club lounge would be located within the concourse paid area, close to the entrance to the platforms, and will preferably provide natural light. The facility may be operated on a subscription basis as a for-profit enterprise, an amenity included with certain classes of tickets, and/or with frequent traveler status as a prerequisite.

Amenities. The facility may include computers, printers, internet, conference rooms, ticketing, light snacks and beverages, passenger services and concierge services. Dedicated restrooms may be provided for premium club lounge customers.

Designated Stations. Full build-out terminal stations including San Francisco Transbay, Sacramento, Los Angeles, Anaheim and San Diego.

Size. 600 sf minimum.

3.3.4 Public Restrooms

General. Provide public men's and women's restrooms within both the concourse free area and the concourse paid area at terminal stations. Provide restrooms only within the concourse free area at intermediate stations. Additionally, provide two unisex restrooms within the paid area for the disabled and special needs passengers at each terminal station. Facilities and access shall conform to ADA requirements, state, and local codes.

Location. Locate public restrooms adjacent to main circulation routes. Entries will be clearly visible from circulation routes.

Size. Restroom facilities shall be based on projected occupant loads. The minimum occupant load for the facility will be based on applicable code requirements.

Access. Paid area restroom entrances shall be screened vestibules in lieu of doors. Free area restroom entrances shall be provided with lockable doors. Access to free area restrooms will be controlled by station staff.

Provisions. Toilet stalls are to be oversized (minimum 3'-0" wide x 6'-0" deep) to accommodate passengers with luggage. Partitions are to be ceiling-mounted. All surfaces and fixtures are to be vandal resistant. Washable surfaces and floor drains are required. Accessories will include hands-free air dryers, soap dispensers, paper towel dispensers, toilet paper dispensers, framed mirrors, and foldable baby changing tables in both men's and women's restrooms.

A janitor room will be provided adjacent to every set of public restrooms.

3.3.5 Commercial Spaces

General. Allocations for commercial space are not dictated by this document as such spaces are not necessary for high-speed train operation. Station design shall reflect the Authority's *Adopted HST Station Development Policies* (May 14, 2008) (http://www.cahighspeedrail.ca.gov/highspeedtrain_stationdev_policies.aspx) which encourages a high density of population, jobs, commercial activities, entertainment and other activities around stations.

Size. It is likely that passenger amenity services will be provided at stations. In order to not preclude addition or inclusion of these spaces, a standard assumption for passenger amenity space can be used to advance station design as shown in Table 3-3.

Table 3-3: Preliminary Passenger Amenity Space Allocation

2035 Daily Boardings	Passenger Amenity Space
Less than 5,000	3,000 sf
5,000-10,000	6,000 sf
More than 15,000	10,000 sf

Location. If commercial space is provided in the free or paid area, it will be located close to major passenger circulation routes or waiting areas. Commercial spaces and the patrons they attract shall not impede high-speed train passenger flow.

Services. Routes to supply commercial spaces will be different from passenger circulation routes. Each commercial space will be an independent fire zone. Electrical and mechanical building services for each commercial space will be separately controlled and metered.

3.3.6 Slope and Drainage

Station drains will be provided in concourses. However, floors need not slope to drains. Where weather protection cannot prevent wind-blown rain from entering the station, slope floors to drains.

3.4 PLATFORMS

The primary function of station platforms is the boarding and alighting of trains. Platforms shall be open with high visibility. Columns shall be limited in size and in quantity. Corners, recessed areas and other areas which may be used for hiding will be minimized.

Access from the concourse will be arranged to encourage distribution and collection of passengers along the entire platform length.

3.4.1 Platform Geometry

Platform geometry is discussed in TM 2.2.4 Station Platform Geometric Design. Topics addressed include:

- Platform configuration
- Platform length
- Platform width
- Platform cross slope
- Platform longitudinal slope
- Platform curvature
- Platform height
- Track centerline to platform dimension
- Platform edge to train gap
- Setback of obstructions from edge of platform
- Under platform refuge area
- Platforms adjacent to through tracks
- OCS poles on platforms.

3.4.2 Platform Capacity

Width: Since the platform length is a fixed function of vehicle length, the width of the platform must accommodate the predicted volumes of passengers boarding and alighting from trains during normal and irregular operation. Minimum platform widths for center and side platforms are indicated in T.M. 2.2.4. Platform width shall be the larger of the minimum platform width in TM 2.2.4 and the platform width as required by the platform occupant load.

Occupant Load: Adequate platform capacity must be confirmed by first calculating the maximum Platform Occupant Load (POL), The POL is the maximum number of passengers who will gather on the platform during the interval immediately following the departure of one train and the arrival of the next during the peak hour.

Irregular Operation: During normal operation, passengers will alight in accordance with estimated peak hour flow. However, there may be causes (mechanical or operational) for all passengers travelling in a fully-loaded train to disembark at any station. These passengers will detrain onto a platform already occupied by peak hour passengers waiting to board. At intermediate stations, maximum platform occupant load during irregular operation therefore will be one full train per platform edge plus boarding load in peak or non-peak direction. At terminal stations, maximum platform occupant load during irregular operation will be one full train plus boarding load in peak direction.

Emergency Evacuation: This irregular operation scenario is also the basis for emergency evacuation of the platform occupant load which is described in Section 3.13.

Minimum Platform Area: The platform shall be sized to accommodate the POL allowing 25 ft^2 per boarding passenger for passengers to circulate and wait during the peak (walkway LOS B). Upon train arrival the addition of alighting passengers on the platform may result in a temporary LOS C for a short duration. Minimum platform area shall be exclusive of the 2'-0" safety edge strip, platform obstructions such as escalators, stairs, columns or other fixed elements.

3.4.3 Platform Edge

Platform edge design and materials shall be standardized throughout the CHST system. Provide a standard 24" wide clear zone of a thick, durable floor finish material along the entire length of each platform edge. This edge shall be visually accentuated with an adjacent 4" wide continuous strip of contrasting color. Adjacent to this accent strip provide a continuous 12" wide strip of ADA compliant tactile warning tiles in a contrasting color. Provide continuous lighting along the platform edge. Refer to other sections of this document for additional platform finish and lighting information. A platform edge standard drawing is to be developed.

3.4.4 Platform Ends

The ends of platforms shall be delineated by railings and security gates at elevated and at-grade platforms, or end walls and gates at underground stations. Platform end gates shall be alarmed and appropriate signage applied to discourage unauthorized entry to the trackway or walkways. Stairs shall be provided as needed between platform and walkways.

3.4.5 Non-Public Ancillary Spaces

Some systems, operations, and maintenance spaces will be necessary on the platform, adjacent to it, or beyond its ends. Locate these spaces where circulation flow and clear lines of sight will not be obstructed. These spaces will be accessible to authorized personnel only and include track safety walks, platform-end emergency exit stairs, maintenance, mechanical and storage rooms. Underground and terminal stations may require special platform ancillary spaces as described in Section 3.6.5.2.

Under platform space may be used to run cables and other mechanical and electrical systems. Divided sections shall be separated by 2-hour rated firewalls.

Platforms will include operations and maintenance spaces including a Platform Agent Booth at terminal stations (Section 3.8.1.11), cleaning rooms at selected stations, and storage rooms at selected stations.

3.4.6 Weather Protection

Canopies: Canopies shall be designed so that they can be provided along the entire length of the platforms and extend transversely from the outer wall of the platforms to at least 12" beyond the platform edge. Canopies shall be designed to protect passengers from rain and sun but are not required over passing tracks or stopping tracks. Coordinate canopies with the overhead catenary system (OCS). Actual longitudinal extent of canopies will consider ambient climatic conditions and other factors.

Wind Screens: Wind screens are not required but may be used if local climate would lead to passenger discomfort without them. Windscreens shall be transparent with minimum framing to ensure visibility. Windscreens shall be detailed with consideration for regular maintenance needs. Clear glazed enclosures with seating are an acceptable alternative.

Windscreen design shall not obstruct views or circulation.

3.4.7 Platform Amenities

Refer to Section 3.8 for furnishings, fixtures and equipment to be provided on platforms.

3.4.8 Train Stopping Position

It is assumed that both 200m and 400m trains will be operated from commencement of system operation. Platform finishes, equipment and signage will therefore reflect the use of both shorter and longer train lengths.

3.5 STATION CIRCULATION

3.5.1 General

Effective station planning provides passengers with clear circulation patterns, as consistent as possible from station to station, in order that passengers are able to quickly and easily make their way through the CHST system. Station circulation spaces include passenger walkways, elevators, escalators, stairs, and ramps, as well as emergency routes and non-public corridors. Access and circulation shall be simple, obvious, and comfortable, recognizing many passengers will be unfamiliar with travelling on a high-speed rail system.

3.5.1.1 Basis for Circulation Sizing

Generally, station passageways and other circulation spaces will be sized based on peak period flows during normal station operations. Under these conditions, facilities shall be designed to a Fruin LOS B or better for walkways and concourse spaces and shall be in compliance with ADA and NFPA 130 requirements. Where space is constrained by physical conditions that cannot be mitigated cost-effectively, high-speed train facilities may be designed for a peak LOS C as approved by the Authority. If both NFPA 130 and ADA address an issue, the more restrictive of the regulations shall be followed.

Total peak hour pedestrian volume will be distributed between all circulation elements in the station. Passageways shall have a capacity at least equal to the capacity of any stairs and elevators that feed it. Corridors leading directly to/from platforms shall be sized to accommodate the expected surge loadings of boarding and/or alighting passengers.

3.5.1.2 Circulation Principles

Circulation patterns shall consider the following:

- **Right-hand rule**: Observe right hand flow for pedestrian circulation.
- **Cross Flows**: Avoid cross flows wherever possible.
- **Dead ends**: Avoid dead end conditions wherever possible.
- **Obstructions**: Columns, queues, kiosks, equipment, etc. shall not encroach into circulation routes.
- **Directional travel**: Circulation routes and station layouts shall minimize changes in direction.
- **Visual orientation**: Circulation routes and station layouts shall facilitate passenger orientation by means of placing each sequential stage of circulation (ticket gates, escalator, platform, etc.) in clear view of the current stage.
- **Decision Points**: Where there is a need to make a directional decision, avoid the necessity for passengers to make multiple decisions at a single location.
- **Safety**: Avoid concealed corners or recesses which may be used as hiding places. Passengers' perception of safety is a fundamental system requirement.

3.5.1.3 Space Allocation

Circulation space allocation shall provide for the following needs:

- **Width:** Provide sufficient width to accommodate passengers walking at average speeds as specified in the following sections.

- **Luggage:** Provide additional circulation space where passengers may be travelling with luggage, strollers, bicycles, etc.
- **Queuing:** Provide space for passengers to queue at circulation elements per
- Table 3-4. Do not overlap queues or encroach into primary circulation routes. Due to the fact that escalators will be reversible, unobstructed queuing space shall be allocated at both the top and bottom of every escalator.
- **Run-offs:** Allow an additional 10' distance beyond escalator queuing distance to allow for passengers to move away from passenger circulation elements and make decisions without obstructing other passengers.

Table 3-4: Queuing Distance Requirements

Element	Dimension (min.)
Escalator (top and bottom from working points)	15'-0"
Stair (top and bottom from first tread)	15'-0"
Elevator Entrance	8'-0"
Ticket Gates, both free and paid sides	20'-0"
Ticket Sales Windows	20'-0"
Ticket Vending Machines	8'-0"

3.5.1.4 Platform Access

Platform access will be located and designed to minimize platform travel distance where feasible.

3.5.1.5 Non-public Circulation

Where possible, separate non-public circulation routes for station and train staff, goods and supplies, and refuse collection.

3.5.2 Horizontal Circulation/Walkways

3.5.2.1 General

Adequate horizontal circulation width is essential to achievement of the general circulation principles listed in the preceding section. Horizontal circulation width provisions are based upon accommodating the flow of a given number of passengers during the peak minute, occupying a given width and walking at a given average speed.

3.5.2.2 Constraints

Horizontal circulation may be constrained by walls, barriers or platform edge as in a passageway, platform or corridor, or it may be unconstrained as in an open concourse or mezzanine. Where passageways are constrained, extra width must be added to account for a "buffer zone" which is a distance from which people tend to stay away from vertical surfaces when walking.

3.5.2.3 Passageways

Calculated Width. Minimum net width of any passageway shall be calculated on the basis of the sum of the peak 15 minute boarding and alighting passenger flows.

Passageway width may be calculated based upon LOS B horizontal circulation unit capacity (10 people per foot per minute) during peak minute surges as shown in Table 3-5.

Table 3-5: Passageway Width Calculation

Symbol	Description	Formula [1, 2, 3]
Pu	Unconstrained Passageway width	$(P_{15B} + P_{15A}) \div (15 \times 10$ p/ft/m)
Pc	Constrained Passageway width	Pu + B

[1] P_{15B} = Peak 15 minute boardings; P_{15A} = Peak 15 minute alightings

[2] at LOS B,

[3] B = Buffer Zone: 1'-6" for space adjacent to each wall, barrier or railing, 2'-0" at platform edge except in cases when the train remains at the platform edge such as during emergency train evacuation

Minimum Width. Provide the greater of the calculated passageway width and minimum passageway widths as shown in Table 3-6.

Table 3-6: Passageway Width Minimums

Element	Dimension
Public areas	16'-0" preferred minimum
Public areas with unidirectional movement	6'-0" absolute minimum
Public areas with bidirectional movement	8'-0" absolute minimum

Equivalent Capacity: Passageways shall have a capacity at least equal to the capacity of any stairs and escalators that feed it. Passageways leading directly to/from platforms shall be sized to accommodate potential 50% surge loadings of boarding and/or alighting passengers.

3.5.2.4 Corridors

At non-public spaces, corridor width connecting service and plant rooms shall be no less than 3'-8" clear width or as determined by building code. Corridor width shall consider access needs for installing or replacing equipment.

3.5.2.5 Pedestrian Bridges and Tunnels

Minimum width of pedestrian bridges and underground tunnels shall be calculated in the same way as described in Passageways above. Natural light shall be introduced into bridges.

3.5.2.6 Height

Minimum horizontal circulation ceiling height shall be 10'-0" above finish floor. Suspended signs, fixtures or fittings must have a vertical clearance of at least 8'-0" feet above finish floor or as required to conform to accessibility standards.

3.5.2.7 Floor Slope

Floors of horizontal circulation elements shall not exceed 5% slope.

3.5.2.8 Moving Walkways

Where continuous horizontal concourse or passageway circulation distances exceed 400 feet, the use of moving walkways may be considered.

3.5.3 Vertical Circulation

3.5.3.1 Planning Principles

Primary Mode. Provide escalators as the primary mode of vertical circulation to accommodate normal peak period boarding and alighting passenger flows within station public areas. Elevators may not be utilized as the primary mode of station vertical circulation.

Secondary Mode. Provide stairs in addition to escalators as required for emergency evacuation. Refer to Section 3.13 for means of escape during station evacuation.

Pairing. Stairs will be combined with escalators where space allows as an alternative to escalators in the case of overloading, emergency, or maintenance.

Escalator Alternative. Provide at least one stair between levels for passengers who prefer not to use escalators.

Right-hand Flow. Stairs will generally be located to the right of a single escalator for a passenger preparing to descend. When stairs are adjacent to two escalators, the stairs will be located between the escalators. If the stairs are wider than 15 feet, the stair may be divided and moved to the outside of the escalators.

Orientation. Stairs and escalators shall be oriented to direct passengers towards their destination and avoid U-turns.

Slope. Where stairs are paired with escalators, the slope of the stairs shall match the slope of the escalators.

Future Stair Replacement. Stairs shall be designed so that they may be replaced by escalators if demand requires in the future, if feasible. This includes the stair support structure and space allocations for escalator operational elements.

Vertical Distance. Where vertical circulation is to be provided in excess of that required for peak flows, provide an escalator for upward flow wherever the vertical travel distance exceeds 10'-0". Provide an escalator for downward flow wherever the vertical travel distance exceeds 25'-0".

3.5.3.2 Escalators

Quantity. Escalator quantities vary by station and demand. Provide at least one extra escalator between concourse and platform levels as a backup during escalator maintenance.

Installation. Escalators shall be installed at 30 degree slope between lower and upper working points. Refer to architectural directive drawings for additional dimensional criteria. Provide lifting hooks above escalators for initial installation and future replacement.

Specifications. Per Table 3-7. Additional technical information regarding escalators will be developed at a later date.

Table 3-7: Escalator Criteria

Escalator Elements	Planning Criteria
Type	Heavy-duty reversible
Operation	Operated either from station control room or locally by key
Tread Width	40"
Flat Steps	5 flat steps at top landings and 4 flat steps at bottom landings
Speed	Dual-speed, 90 ft. / min. and 120 ft. / min
Capacity	70 people per minute
Opposing Escalators	80'-0" minimum working point to working point
Clear Headroom	10'-0" absolute minimum above nosing

Emergency Operation. In emergency situations, escalators running reverse to the exiting direction can be stopped remotely and used as stairs for exiting. Provide escalators with an emergency stop button with accompanying signage.

Weather Protection. Escalators shall be protected from direct rainfall by a roof or canopy.

Queuing Distance. Refer to Section 3.5.1 for escalator queuing requirements.

Runoff Space. Provide 10'-0" run-off distance beyond escalator queues to allow passengers additional time and space to move away from the escalator and make directional decisions without obstructing other passengers.

Side Clearances. Refer to Directive Drawings for clearances between structural members and floor slabs to allow for escalator truss and finish materials.

Machine Spaces. Provide each escalator with an upper machine space and a lower machine room (or pit) housing motors and other escalator equipment. Machine spaces shall be adequate for machine maintenance and accessible from removable floor cover plates. When located in ceiling above public spaces, conceal machine space within the suspended ceiling. Provide drainage of escalator machine rooms for maintenance and cleaning.

3.5.3.3 Public Stairs

Quantity. Provide stairs in addition to escalators where required to accommodate NFPA 130 emergency egress conditions. Refer to Section 3.13 for emergency evacuation criteria.

Width. Stairs required for emergency evacuation shall provide exiting capacity as required to supplement the escalator emergency capacity. Minimum public stair width shall be as required by NFPA 130 or in Table 3-8 (whichever is greater).

Table 3-8: Stair Width Minimums

Element	Minimum Width
Stairs next to escalators	6'-0"
Platform stairs	6'-0"
Stair-only entrances	8'-0"
Emergency stairs	6'-0"

Configuration. Public stairs used during normal operation will run in a single direction between levels. Stairs treads, risers and related details shall conform to all applicable state and local building codes.

Alignment. Align lower stair working point with lower escalator working point. Stairs shall slope at 30 degrees to align with escalators.

Landings. Stair runs shall be no greater than 12'-0" without a landing.

Queuing Distance. Refer to Section 3.5.1 for stair and escalator queuing requirements.

Handrails. Handrails shall be provided on both sides of all stairs. For stairs required to be wider than 7'-4", provide an intermediate handrail.

Emergency stairs. Provide emergency stairs where escalators and stairs provided for normal operation are insufficient for emergency evacuation of the station. Emergency stairs shall be easily accessible from public areas but shall not be used during normal operation. No ancillary rooms shall be accessed from the emergency stairs.

Headroom. Minimum headroom above all public stairs shall be at least 10 feet.

Materials. Stair treads and nosings shall be constructed of slip-resistant, robust, non-combustible materials, suitable for and proven to be utilized in high-traffic transportation areas. The leading edge of nosings shall be eased to ¼" to ½" radius. Risers shall be raked back a minimum 1" from edge to back of the tread below.

To facilitate cleaning and avoid build-up of dirt against stair side walls, all public stairs shall include continuous 6" wide side troughs. These shall be continuous from top to bottom of stairs on both sides except where open railings are installed. Where exposed to weather, provide a floor drain at the bottom of the trough.

Weather Protection. Stairs may be covered depending on level of use and expected level of inclement weather for station region.

3.5.3.4 Non-Public Stairs

Stairs within non-public areas shall conform to state and local building codes.

3.5.3.5 Ramps

Ramps may be utilized where there are small changes in elevation or for wheelchair access. Ramp width follows horizontal circulation requirements and shall comply with ADA Accessibility Guidelines. Ramps may be appropriate vertical circulation instead of a small number of stairs.

3.5.3.6 Passenger Elevators

General. Elevators will be provided and designed for disabled patrons, patrons carrying large luggage, strollers, bicycles, stretchers, and the movement of supplies. Wherever access to the platform requires a change of level, an elevator is required.

Quantity. At least one elevator shall be provided to connect each station level. Space shall be provided for the future addition of an additional, redundant passenger elevator between station levels. Two or more elevators may be required initially at terminal stations in order to accommodate passenger flow requirements, especially passengers with luggage.

Location. Where possible, elevators between concourses and platforms will be located near the center of the platform. Where Platform Agent Booths are provided, elevator doors shall face the Platform Agent Booth and not the platform edges.

Size. Elevators shall be 4000 pound hydraulic passenger type with center opening doors. Elevators should be sized to move standard station maintenance equipment between levels.

Speed. Rated travel speed shall be either 125 fpm or 150 fpm with a maximum wait time of 30 seconds.

Queuing. Refer to Section 3.5.1 for elevator queuing requirements.

Emergency Egress. Elevators will not be included in the calculation of platform egress capacity and will not contribute capacity for pedestrian movements within the station.

Materials and Finishes. Elevators shall be glazed on three sides with clear glass to increase a real and perceived sense of safety. Doors shall be provided with glazed vision panels. Hoistway structure shall be heavy steel framing. Solid wall and ceiling panels shall be Type 3XX brushed stainless steel. Floors shall be non-slip, durable material proven to be appropriate in a heavy-use transit environment.

Machine Rooms. Elevator machine rooms shall be located at the lowest level, as close as possible to the elevator.

Weather Protection. Elevator entrances shall be covered to protect passengers and facilities from inclement weather.

3.5.3.7 Service Elevators.

General. Provide at terminal stations only for movement of goods, refuse and equipment between station levels for train inspecting, cleaning, restocking and repairs. Passenger elevators shall not be used as service elevators.

Number. There shall be one service elevator serving each platform at terminal stations. Provide service elevators at intermediate stations only where it is anticipated there will be frequent movement of goods or equipment between the non-public areas and platforms. Provide a service corridor either beneath or above track level connected to the non-public station areas.

Capacity. Provide minimum 3000 pound capacity hydraulic service elevators.

3.6 NON-PUBLIC/ STATION SUPPORT AREAS

3.6.1 General

This section pertains to non-public areas of the station required for the operation and maintenance of the station and the system. These include passenger service areas, station and system operation offices and other ancillary spaces including maintenance and building services.

Size. Refer to Room Data Sheets for minimum dimensional requirements for non-public areas. Room sizes and numbers may vary between stations depending on the station's location, type and function. Where room areas and/or heights are not indicated, provide a reasonable amount of space anticipated for each specific station.

3.6.2 Passenger Service Areas

3.6.2.1 General

Passenger service spaces provide services directly to station patrons. As such, they must be adjacent to station public areas and preferably located at ground level. Many of these spaces will be consistent throughout the system in order to provide continuity and familiarity to passengers. These spaces shall conform to accessibility requirements. The following is a non-exhaustive summary of these spaces.

3.6.2.2 Ticket Sales Office

Function. At the ticket sales office, passengers are able to buy tickets directly from station staff. Other ticketing transactions may also be conducted including refunds, ticket adjustments, or retrieval of reserved tickets.

Location. One secure ticket sales office shall be provided at each station concourse free area between the public and non-public areas and be easily visible from station entrances. In the event that a station provides more than one Free Concourse, a second ticket sales office may be required only if warranted by substantial patronage. Access shall be via a secure corridor, through a security door with viewing panel.

Window Quantity. All stations shall provide a minimum of two ticket windows to accommodate ticket clerk shift changes. Total ticket windows, if more than two are required, shall be provided to meet peak passenger demand as follows:

Ticket windows = $(P_{60B} \times A) \div (B \times C) = P_{60B} \div 600$

A = Percentage of P_{60B} making ticket window transactions (assume 15%)

B = Tickets sold in each ticketing transaction (assume 1.5)

C = Hourly rate at which transactions are processed per ticket window (assume 60)

The formula above assumes approximately 80% of all peak hour passengers will purchase tickets at the station, of which 20% will make their purchase at the ticket window in lieu of the ticket vending machines. The number of windows will be rounded up to the nearest whole number. At least one ticket window space will accommodate disabled passengers.

Office Size. Each window shall be minimum 5'-0" wide. Provide a minimum of 75 ft^2 of ticket office area for each window. Refer to Section 3.5.1 for queuing distances at ticket windows. Refer to directive drawings for typical ticket windows.

Related Provisions. Ticket Vending Machines (TVMs) shall be located near the Ticket Sales Office and within view of the ticket office queuing area. Requirements for TVMs are outlined in Section 3.7.1. Ticket sales administrative offices and other ticketing-related offices shall be adjacent to these facilities.

3.6.2.3 Passenger Service Booth

Refer to Section 3.8.1.2 for design criteria for this standard system-wide freestanding booth situated adjacent to the fare gate array between the concourse free area and paid area.

3.6.2.4 Passenger Information Counter

Refer to Section 3.8.1.9 for design criteria for this standard system-wide freestanding counter situated within the concourse free area.

3.6.2.5 Lost and Found

Function. Space is used to store and manage passenger's lost items as well as to collect and return these items to and from passengers.

Location. Concourse free area, adjacent to the Station Manager Office.

Provisions. At intermediate stations, minimum area 80 ft^2. At terminal stations, minimum area 120 ft^2. Provide door opening into the Concourse free area as well as an interior door connecting with the Station Manager's Office. Provide storage shelving and an internal passenger service counter.

3.6.2.6 Police Office

Function. Selected stations will provide an office for police responsible for station surveillance, passenger interface and railroad security.

Location. Located near the station entrance, between the public and non-public areas. This office will be located so that it can be open to the public area with a counter. Locate adjacent to the security office.

Provisions. Minimum area 160 ft^2. Some stations may require holding cells and/or canine support facilities as well.

3.6.3 Station Operation Offices

3.6.3.1 General

These back-of-house areas are offices and other spaces which have no public contact. These spaces include station administration offices, ticketing back offices, station control and operations spaces, train crew spaces, and maintenance spaces. Rooms and spaces will be arranged into suites according to function and have separate non-public accesses. Access control will be appropriate to each function. It is preferable for these offices to be located at concourse ground level unless otherwise indicated. The following is a non-exhaustive list of these spaces.

3.6.3.2 Station Administration Office

Function. Station administrative tasks are performed in this space. Some staff may have dedicated workspaces while others may share.

Location. Adjacent to the Station Manager's office.

Provisions. Minimum area 100 ft^2 per assigned staff.

3.6.3.3 Station Manager's Office

Function. This serves as the office for the Station Manager.

Location. Adjacent to other non-public administrative offices.

Provisions. Minimum area 270 ft^2.

3.6.3.4 Training and Meeting Room

Function. This room will be included in selected stations and is used for staff meetings, staff training and emergency command.

Location. Adjacent to the Station Administration Office.

Provisions. Minimum area 200 ft^2.

3.6.3.5 Station Control Room

Purpose. The Station Control Room is where passenger circulation, ticketing, fare control, security, and building service operations are monitored and controlled. Local train operation, traction power, signaling, and communication may also be temporarily controlled from this room in the event that the Central Control Facility (CCF) is not operational.

The Station Control Room may also function as an incident response command center. This will be the place where first responders would coordinate activities with station personnel in the event of an emergency or security incident.

Location. Designers need to be familiar with the operating plan and coordinate their efforts with the systems designers to determine the appropriate location and configuration of any such facilities at CHST stations.

Provisions. For initial planning purposes, provide a minimum area of 1,100 ft^2. Provide access flooring for underfloor cable routing. Layout for the Station Control Room will be in accordance with a system wide standard to be developed.

3.6.3.6 Station Computer Room

Function. The Station Computer Room houses the servers that are needed in order to operate the ticketing and station operation systems.

Location. Adjacent to the Operation Maintenance Office.

Provisions. Minimum area 500 ft^2. Controlled heat and humidity and a link to the Uninterrupted Power Supply (UPS).

3.6.3.7 Ticket Administration Office

Function. Used for non-public administrative ticketing functions.

Location. Adjacent to the Ticket Sales Office.

Provisions. Minimum area for the Ticket Administration Office 160 ft^2. Provide cash handling and ticket storage in an adjacent secure room.

3.6.3.8 Cash Handling and Ticket Storage Room

Function. Used for processing cash received from ticket sales and for storage of blank tickets.

Location. Adjacent to the Ticket Administration Office. A secure route shall be provided from this area to a place where money and tickets can be transferred to money transport vehicles.

Provisions. Minimum area for cash handling and ticket storage 260 ft^2 including a partitioned 60 ft^2 for ticket storage. A safe will be provided in this room for temporary storage of tickets and cash.

3.6.3.9 Security Office

Function. This office provides a control center for station security.

Location. The Security Office will be located adjacent to the Station Administration Office and the Police Office.

Provisions. Minimum area 160 ft^2 .The office will have video screens to monitor the station area CCTV.

3.6.3.10 Facility Maintenance Office

Function. Building services administration and maintenance.

Provisions. Minimum area 330 ft^2 .

3.6.3.11 Operation Maintenance Office

Function. Administration work and parts/equipment storage for the system operations and engineering staff.

Location. Accessible to the loading dock. Operation Maintenance Offices are required at terminal stations and other selected stations.

Provisions. Minimum area 1,100 ft^2.

3.6.3.12 Staff Break Room

Function. For station staff on break.

Location. Grouped with other staff functions.

Provisions. Minimum area 200 ft^2 or as required to provide 25 ft^2 per staff within a typical shift. Provide basic kitchenette facilities within the Break Room. At intermediate stations provide staff lockers within the Staff Break Room for storage of personal items.

3.6.3.13 Staff Locker Rooms

Function. Personal storage and showering for male and female staff during shift.

Location. At Terminal Stations only, grouped with other staff functions.

Provisions. Size as required for estimated staff numbers during a typical shift. Provide individual lockable lockers and benches for changing clothes. Provide shower rooms separated from the locker area. Size and quantity to be determined by California Building Code.

3.6.3.14 Staff Restrooms

Function. Men's/women's toilets dedicated for staff in addition to public restrooms and in accordance with the building code.

Location. At terminal stations only. Staff Restrooms will be located in the Station Operations Office area and adjacent to the Staff Locker Room and Staff Break Room. At intermediate stations staff will use Public Restrooms.

Provisions. Size and fixture quantity to be determined by California Building Code.

3.6.3.15 Platform Agent Booth

Refer to Section 3.8.1.11 for design criteria for this standard system-wide freestanding booth situated within the platform.

3.6.3.16 Transportation Agency Offices

Local or regional transportation agencies may be interested in having offices within stations. Inclusion and sizing of this space would vary by station and will be determined based on coordination with local agencies.

3.6.4 Ancillary Spaces

Other station ancillary spaces may include the following.

3.6.4.1 Refuse Storage Room

Function. Space to store an appropriate volume of recycling and waste produced within the station during a maximum three-day period between pickups.

Location. Refuse storage will be located where collection trucks can collect, away from public areas and outside of the station where feasible.

Provisions. Minimum area shall be 150 ft^2 or as required to accommodate current recycling requirements with flexibility to accommodate future changes. Terminal stations will require additional area. Accommodate waste generated over three days on trains, within station, and by commercial establishments within the station. Provide a hose bibb and floor drain.

3.6.4.2 Cleaning Supply Rooms

Function. Storage space for cleaning supplies.

Location. Adjacent to the Concourse free area, the Concourse paid area and the Platform. Cleaning supply rooms shall also be located near each set of toilet facilities.

Provisions. Minimum area 80 ft^2 . Provide a janitor's sink, mop and broom racks.

3.6.4.3 Station Storage Rooms

Function. General storage.

Location. Adjacent to the Concourse free area, the Concourse paid area, and on the Platform.

Provisions. Concourse minimum area 150 ft^2 . Platform minimum area 100 $ft^{2.}$

3.6.4.4 Landscape Maintenance Storage Room

This room will have space for landscaping tools and supplies and basic work. It will have direct access to outdoors.

3.6.4.5 Miscellaneous Rooms

- Storage for luggage/servicing carts and battery storage/charging for such carts: 200 ft^2.
- Staff equipment storage: 60 ft^2
- Consumables storage: 60 ft^2
- Advertising storage: 60 ft^2
- Materials storage: 60 ft^2
- Small materials storage: 60 ft^2

3.6.5 Terminal and Turnback Station Operations Facilities

Provide space to support the cleaning, re-stocking, provisioning and preparation of trains prior to turning at terminal stations or other stations based on the operations plan. This may also include additional area for train crews, on-board security staff, cleaning crews, and mechanical crews (including break rooms, locker rooms, ready room, train crew sleeping quarters, and/or ticket receiver's office).

3.6.5.1 Train Crew Support

Spaces required for train crews at terminal stations, which may include shift changes and waiting spaces while trains are being turned, include the following:

- Team Leader Office. 120 ft^2
- Shift supervisor Office. Includes space for four shift supervisors. 400 ft^2
- Administrative Support Office. Room for one support staff. 100 ft^2
- Train Crew Restroom. 100 ft^2
- Supervisor Lockers/Shower. 200 ft^2
- Ready Room. 400 ft^2
- Train Crew Lockers/Showers. 200 ft^2

3.6.5.2 Platform Maintenance Operations

Spaces required for minor maintenance and inspection of the trains and platform include the following:

- Gang Foreman Office.100 ft^2
- Car Inspector Office. Includes space for two car inspectors. 120 ft^2
- Cleaners' room. One 120 ft^2 room shall be located on each platform. Each room will accommodate two cleaners.
- Maintenance lockers, showers and restrooms. 200 ft^2
- Refuse Rooms. Three 75 ft^2 refuse rooms will be located at platform level.
- Maintenance Equipment Storage Lockers. Three 160 ft^2 maintenance equipment storage lockers will be located at platform level, distributed along the length of the platform under escalators or stairs for tool and miscellaneous storage. Provide water and power.
- Cleaning machine storage and charging 660 ft^2
- General Storage Lockers. 400 ft^2 total area, distributed along the length of the platform, under escalators or stairs where possible, for restocking of trains.

3.6.5.3 Commissary Requirements

Spaces required at terminal stations to provide for commissary service on the high-speed trains include the following:

- Commissary Office.120 ft^2
- Food Store Room. 800 ft^2, accessible from the loading dock
- Commissary Lockers/Shower/Restroom. 350 ft^2

3.6.5.4 Turnback Stations

Particular intermediate stations may be operated as turnback stations. Provide these stations with crew waiting and changing spaces.

3.6.6 Station Building Service and Standard Plant Spaces

Potential systems to consider include but are not limited to: environmental control, electrical, fire protection, and plumbing and drainage. Station design shall accommodate the building systems and meet the requirements of applicable codes. Additionally, facilities necessary to meet LEED Silver standards and corresponding efficiency and energy use standards shall be included, as determined by the designer.

Access and hoisting provisions shall be provided for installation and future replacement of station equipment. Ceiling height in equipment rooms shall be 16'-0" minimum to permit equipment placement and overhead utility routing.

3.6.6.1 Environmental Control

Spaces for the environmental control system may include the following:

- Chiller Room
- Air Handling Unit (AHU) Room
- Ventilation and Exhaust Room
- Smoke Extract Room
- Tunnel Ventilation Room
- Motor Control Center Room

3.6.6.2 Electrical System

An external substation Facility Power Substation will be required on the station site for the purpose of providing normal, backup, and emergency standby power to the station. Substation will be located within a 10,000 ft^2 fenced area that contains high voltage (HV) switchgear, HV transformers, emergency generator, and a fuel storage tank. The generator and adjacent fuel tank shall be a minimum of 25'-0" from any station structure and separated from adjacent properties. Provide service vehicle access.

Spaces for the Facility Power system within the station may additionally include the following:

- Low Voltage (LV) Distribution, Transformation, and Emergency Power Source (i.e., UPS) within Decentralized Electrical Room – 900 ft^2. Two rooms required; one room located at each side of station.
- LV Batteries (within Dedicated Battery Room. – 200 ft^2. Two rooms required; one room located at each side of station.

3.6.6.3 Fire Protection

Spaces for the fire protection system may include the following:

- Fire Pump Room
- Fire Water Tank Room
- Clean Gas Room

3.6.6.4 Plumbing and Drainage

Spaces for the plumbing and drainage systems may include the following:

- Sewage Equipment Room
- Sewage Treatment Plant
- Sewage Control Room
- Water Tank Room
- City Water Pump Room
- Sump Pump Room
- Ejector Room

3.6.6.5 Emergency Generator Room

An external Generator Room will be required on the station site for the purpose of providing emergency standby power to the station. See Section 3.6.6.2.

3.6.7 Railroad Systems Facilities

Facilities needed for HST systems are addressed in other technical memorandums, specifically TM 3.3.2 Train Control Site Requirements and TM 3.4.2 Communication Site Requirements. Potential systems to consider include but are not limited to: communications, signaling systems,

traction power, and rail infrastructure maintenance. Station design shall accommodate the systems and operational requirements and meet the requirements of applicable codes.

3.6.7.1 Train Control and Communications System

Spaces for the train control and communications system may include the following:

- Train Control and Communications Room – 1,280 ft^2
- Communication Battery Room – 160 ft^2
- Third Party Communications Room -- 160 ft^2

3.6.7.2 Other HST Facilities

Spaces for other HST facilities may include the following:

- Electric Switch Room – 160 ft^2
- Battery Room – size to be determined

3.6.8 Service Access

3.6.8.1 General

Terminal stations require service access between all platforms, the back-of-house areas of the station, and the station loading zone. Ideally, these access routes will not cross circulation routes within the station public areas. These corridors will be used by station staff and maintenance personnel and will not be accessible to the public.

3.6.8.2 Service Elevators

At terminal stations, service elevators separate from the passenger elevators shall be provided to each platform, connecting with a service corridor that passes above or below the platforms and provides direct non-public access to the station's back-of-house facilities. It will be desirable to standardize the location of these service elevators at all high-speed train stations (i.e., at the north end or south end of the platforms), to facilitate train provisioning and servicing. This will require coordination with the trainset design and the developers of the overall operating plan.

3.6.8.3 Service Corridors

Certain station-related service corridors, such as the ones linking the ticket office with the loading zone, which will be used for handling ticket revenue, will be kept separate from service corridors serving the retail and commercial zones of the station. Concrete floors shall be hardened wherever cash carts will be moved.

3.6.8.4 Loading Zone

The station loading zone and service entrance will be sized as appropriate for each station to accommodate station-related deliveries, ticket revenue handling, trash compacting and collection for the entire station, delivery of on-board services supplies (at terminal stations), police and security-related access, and deliveries to retail concessions within the station. Loading zones and related functions will be separated from the main station entrances and circulation patterns to prevent disruption of pedestrian and vehicular flows.

3.6.9 Evacuation from Non-Public Areas

3.6.9.1 General Goal

In the event of an emergency, a safe means of egress shall be provided for staff from non-public areas including operations, systems and plant areas. Refer to Section 3.13 for related emergency station evacuation criteria.

3.6.9.2 Maximum Distance to Exits

The maximum walking distance to a means of escape shall not be more than 130 feet when there are multiple means of escape. When there is only one escape route, the maximum walking distance to a means of escape shall not be more the 65 feet. Any dead-end corridors shall not be longer than 30 feet. Unoccupied mechanical areas may have an escape route that includes a ladder or manhole.

3.6.9.3 Underground Stations

From the tunnel, staff shall exit from the tunnel walkway, up stairs at the platform end and onto the platform. From the platform, staff shall exit the nearest means of vertical circulation up to the mezzanine or concourse. From concourse level non-public areas, staff shall exit into the public concourse and follow the same routes as passengers up to a place of safety at street level.

3.6.9.4 Elevated Stations

From the elevated tracks, staff shall exit from the end of the platform up stairs and onto the platform. From the platform, staff shall exit via the nearest means of platform vertical circulation down to the mezzanine or concourse. From street level concourse, staff shall follow the same route as passengers out to a place of safety at street level.

3.6.9.5 At-Grade Stations

From the at-grade tracks, staff shall exit from the tunnel walkway, up stairs at the platform end and onto the platform. From side platforms, staff shall exit directly out to street level via emergency doors. From a concourse above the platform level, staff shall follow the same route as passengers down to a place of safety at street level.

3.7 PROVISIONS FOR FARE COLLECTION

3.7.1 Elements of Fare Collection

High-speed train stations shall be designed to allow for the use of fare gates. Therefore, the provision for fare collection in the station will include:

- Ticket Sales Office
- Ticket Vending Machines
- Fare Gates
- Other fare collection equipment

These elements affect station functional planning and passenger movement and are summarized as applicable to station planning. Details of fare collection policies and required equipment will be addressed in another document.

3.7.2 Ticket Sales Office

It is assumed that approximately 80% of all peak hour passengers will purchase tickets at the station, of which 20% will make their ticket purchase at the Ticket Sales Office in lieu of the ticket vending machines. Refer to Section 3.6.2.2 for information regarding the Ticket Sales Office.

3.7.3 Ticket Vending Machines (TVMs)

General. It is assumed that 40% of passengers will obtain their tickets at TVMs within the stations, either by purchasing tickets or printing pre-purchased tickets.

Location. Ticket Vending Machines will be located in the Concourse free area near the Ticketing Sales Office and adjacent to the main circulation routes from entrances to the Concourse paid area and Platforms. The machines and corresponding queue space (summarized in Section 3.5.1) must not encroach into the passenger circulation space. Machines will be grouped into clusters. Depending on the size of the station and the number of TVMs, multiple clusters may be appropriate. In most cases, TVMs will be placed against a wall, in view of entrances. For stations with multiple entrances, it may be appropriate to locate TVMs at secondary entrances in order to ensure logical passenger flow.

TVM location will incorporate the CHSTP security and cash removal procedure in location and access.

Quantity. TVMs will be provided to meet peak passenger demand as follows, with a minimum of 3 per station:

$$TVMs = (P_{60B} \times A) \div (B \times C) = P_{60B} / 450$$

A = Percentage of P_{60B} making TVM transactions (assume 40%)

B = Tickets sold in each ticketing transaction (assume 1.5)

C = Hourly rate at which transactions are processed per TVM (assume 120 or 2 passengers per minute)

There will be sufficient TVM redundancy in the case of machine maintenance. For space planning purposes, TVMs can be assumed to be 3'-4" wide, 3'-0" deep and 6'-0" high, spaced at 4'-0" on center. TVMs will fit into the standard station module. Allow space for addition of a minimum of 10% more TVMs in the future if passenger demand requires additional machines.

Queuing Space. Refer to Section 3.5.1 for queuing design information.

3.7.4 Fare Gates

General. If used, fare gates would separate the Free and the Paid areas. Standard gates would accommodate most passengers while oversized gates would be available for people with luggage and persons with disabilities. A Passenger Service Booth (Section 3.8.1.2) will be located adjacent to the main array of gates to assist passengers with operation of fare gates.

Size. Standard width fare gates are 2'-0" clear opening, spaced 3'-0" on center. Oversized gates are 3'-0" clear opening, spaced 4'-0" on center.

Quantity. The number of ticket gates provided for arriving and departing passengers is a based on peak passenger demand and 50 people per minute capacity for fully-open gates per Table 3-9.

Table 3-9: Ticket Gates

Station Type	Travel Direction	Quantity Formula [1,2]
Terminal	Arriving Gates	(Train Capacity / headway in minutes) / 50 ppm ticket gate capacity
Terminal	Departing Gates	(P_{15B} / 15) / 50 ppm ticket gate capacity
Intermediate	Arriving Gates	(1.125 x P_{1A}) / 50 ppm ticket gate capacity
Intermediate	Departing Gates	P_{1B} / 50 ppm ticket gate capacity

[1] P_{15B} = Peak 15 minute boardings; P_{15A} = Peak 15 minute alightings

[2] P_{1B} = Peak minute boardings; P_{1A} = Peak minute alightings

Additional Gates. The number of gates will be rounded up to the next highest integer. Provide one additional gate if the number of required gates is less than 10. Provide two additional gates if the number of required gates is equal to or greater than 10. Where possible, expansion capacity for additional fare gates will be provided.

Oversized Gates. At each ticket gate array, at least one ticket gate must be of the oversized type. More may be necessary for stations which have more passengers with luggage or as required by ADA.

Emergency Gates. At least two emergency and/or service gates shall be provided along the free/paid line to be used by staff and in case of emergency. More gates may be warranted for emergency evacuation.

Queuing. Refer to Section 3.5.1 for queuing distances required at fare gates.

Operation. Under emergency situations, all ticket gates shall remain in the open position.

Provision for Security Measures. In absence of defined security measures at stations, an allowance for potential security space shall be made. This space shall be located on the Free Area side of the gates. The size of this space shall be 20 feet by the total width of the fare gates. The space shall not overlap with any required queuing distances and shall be free of any obstructions.

3.7.5 Other Fare Collection Equipment

3.7.5.1 Ticket Validating Machine

Design guidance for ticket validating machines will be developed at a later date and inclusion will depend on fare collection system adopted.

3.7.5.2 Fare Adjustment Machine

Design guidance for fare adjustment machines will be developed at a later date and inclusion will depend on the fare collection system adopted.

3.8 SYSTEM-WIDE FURNITURE, FIXTURES, AND EQUIPMENT

In addition to equipment described elsewhere in this document, the concourse, both free and paid area, shall be provided with the following system-wide furniture, fixtures, and equipment. System-wide furniture, fixtures, and equipment do not add additional square footage to the station footprint. These elements are included in areas determined in Sections 3.3 - Concourse and Mezzanine and 3.4 - Platforms.

Waiting areas will include power outlets for laptops, Wi-Fi and television monitors.

3.8.1.1 Seating and Benches

Location. Concourse Free Area, Concourse Paid Area, Platforms.

Within Concourse waiting areas, organize into one or more seating groups without obstructing passenger circulation.

On platforms, orient seating parallel to the track within the central zone between vertical circulation elements or columns and protected from the weather. Locating minimal seating near each car encourages passengers to wait near their assigned car. Platform signage will identify where each numbered car will stop.

Quantity. Minimum number of seats to be provided as listed in Table 3-10.

Table 3-10: Station Seating

Symbol	Description	Formula [1]
S_f	Seating at Concourse Free Waiting Area	$[(P_{15B} \times 1.1) + (P_{15A} \times 0.1)] \times 0.25$
S_p	Seating at Concourse Paid Waiting Area	$P_{15B} \times 0.25$
S	Seating on Platforms	4 seats per car (except where seating might obstruct passenger circulation)

[1] P_{15B} = Peak 15 minute boardings; P_{15A} = Peak 15 minute alightings

Description. Seating will be designed with armrests to discourage lying down on seating. Materials shall be corrosion resistant where exposed to exterior elements. Interior seating shall be cushioned and upholstered with a washable, heavy-duty vinyl. Secure seating to floor with vandal-resistant fasteners.

3.8.1.2 Passenger Service Booth (PSB)

Location. Between Concourse Free Area and Paid Area within the fare collection line.

Quantity. One at each fare gate array or dividing line between Free and Paid Areas.

Description. The Passenger Service Booth provides information and assistance to station passengers as they enter or leave the Paid Area. The PSB will be a system-wide standard freestanding unit, approximately 100 square feet in area. Passenger inquiry windows will be provided on both the free and paid sides of the PSB. Provide queuing space 10 feet deep at each

passenger window. Agent access to the PSB will be via a main door on the paid side of the booth. Finish materials will be stainless steel up to approximately 4'-0" height and fully glazed above.

Equipment. The PSB will be fully enclosed, lighted and ventilated. Provide counter work space for the agent to use a computer terminal. Public address capabilities and control of the in-station dynamic signage will be integrated into this booth. This facility requires a good communications link with the station control room and the Central Control Facility to facilitate timely and accurate dissemination of train information to the public.

3.8.1.3 Station Assistance Telephones

Location. Concourse Free Area, Paid Area and Platforms.

Station Assistance Telephones, sometimes called "White Courtesy Phones" offer passengers another means to obtain information or assistance in the event of an emergency.

Quantity. One in each Paid and Free Waiting Area and located at maximum 300' walking distance along the length of each platform.

Description. Refer to Section 3.12 Station Information for additional information.

3.8.1.4 Waste and Recycling Receptacles

Location. Concourse Free Area, Concourse Paid Area, exterior station approaches.

Locate receptacles adjacent to entrances, ticketing facilities and waiting areas. Locations shall not obstruct passenger circulation. Protect receptacles from direct weather exposure.

Quantity. As appropriate for each particular station layout.

Description. Provide triple units for waste, cans and bottles and paper recycling, Materials shall be non-corrosive.

3.8.1.5 Drinking Fountains

Location. Concourse Free Area, Concourse Paid Area.

Quantity. Locate one unit adjacent to each waiting areas, removed from main circulation paths.

Description. Dual height stainless steel, wall-mounted drinking fountains, in accordance with applicable codes. Refer to Section 3.10.3 for additional plumbing information.

3.8.1.6 Public Telephones

Location. Concourse Free Area.

Locate public telephones in groups of at least two phones close to station entrances, adjacent to the concourse free but outside of primary circulation spaces.

Quantity. P_{15B} x 0.01

Description. Coin-operated, wall-mounted or free-standing phones as provided by the local telephone utility service. Comply with ADA accessibility requirements. Integrate public telephones into the station finish module as described in Section 3.9.2.

3.8.1.7 Postal Mailboxes

Location. Concourse Free Area.

Locate postal mailbox close to main station entrance, adjacent to the concourse free waiting areas but outside primary circulation spaces.

Quantity. One per station.

Description. Floor mounted or recessed into modular wall panels, as approved by the U.S. Postal Service.

3.8.1.8 Automated Teller Machines (ATM)

Location. Concourse Free Area.

Quantity. Locate one ATM adjacent to each ticket sales office.

Description. As provided by the designated banking institution for the convenience of passengers buying tickets. ATMs may be freestanding and separated from passenger circulation flows or integrated into the station wall finish module.

3.8.1.9 Passenger Information Counter

Location. At Terminal Stations in the Concourse Free Area, close to the main entrance.

Quantity. One per terminal station.

Description. The Passenger Service Counter will be a system-wide standard design. Each counter will be approximately 100 ft^2. A freestanding counter will be staffed with at least one information agent to provide passengers and station visitors with general information regarding train schedules and use of the high-speed rail system. These counters can also provide information to departing passengers about the local city and modes of connecting transportation available outside the station.

At intermediate stations, these passenger services will be provided at the Passenger Service Booth as described in Section 3.8.1.2.

3.8.1.10 Map and Information Panels

Location. Concourse Free Area.

Quantity. One vicinity map/information panel close to each station entrance/exit, either integrated into the wall finish module or a freestanding kiosk.

Description. Information will also include racks for printed train timetables and other pertinent passenger information. Information panels and kiosks will be a system-wide design and provide information about high-speed train service, including train schedules, fares and policies.

3.8.1.11 Platform Agent Booth (PAB)

Location. Terminal station platforms only, placed at approximately the longitudinal platform center line in order to allow clear visual surveillance of the entire platform.

Quantity. One per platform. Where terminal stations are provided with multiple platforms, each platform shall be provided with one PAB. Area of each booth will be approximately 100 ft^2.

Description. This booth is used to monitor train terminal station arrivals and departures and platform passenger circulation. At intermediate stations the monitoring of passengers entering and exiting trains will be done by the train crew. The PAB will be a system-wide standard freestanding unit, approximately 100 square feet in area. Each PAB will be staffed with an agent and therefore will be provided with a work counter, computer terminal and communications equipment. Agent access to the PAB will be via a main door on the side of the PAB.

Finish materials will be stainless steel up to passenger window height and fully glazed above. The PAB will be fully enclosed, lighted and air conditioned.

Equipment. Public address capabilities and control of the in-station dynamic signage will be integrated into this space. This facility requires a communications link with the station control room and the Central Control Facility, to facilitate timely and accurate dissemination of train information to the public.

3.8.1.12 CCTV

Location. Platforms.

Quantity. As required on platforms to monitor the public area of each platform, with particular emphasis on platform edges, stair and escalator landings, elevator entrances and platform ends.

Description. Refer to Systems Criteria.

3.8.1.13 Emergency Stop Buttons

Locations. Platforms.

Quantity. Spaced along the length of platforms with a 150 foot maximum walking distance.

Description. Refer to Section 3.10.2 for electrical provisions.

3.8.1.14 Baggage Lockers

Locations. Concourse Paid Area, against a wall along a primary circulation route and as close as possible to the Passenger Service Booth.

3.9 STATION FINISH MATERIALS

3.9.1 General Requirements

System finishes impact the durability, maintenance and lifetime of stations as well as contribute to the system image and quality. Station finish materials shall be durable, low maintenance, and have a long design life. Additional guidance for system finish materials, including those for floors, walls and columns, ceilings, and exterior, will be developed after 30 percent design is complete.

3.9.2 Station Design Module

A station planning design module of 4'-0" shall be applied to all station public areas for the purposes of the economy of standard material dimensions, integration and replacement of system-wide elements, and minimization of custom cutting. Structural elements shall be spaces on consistent multiples of this module wherever possible. Finish materials may be subdivided into smaller modular units such as 2'-0" or 12". This basic detail module shall apply to vertical and horizontal surfaces.

3.10 STATION ENVIRONMENT

3.10.1 Lighting

The lighting criteria contained herein are intended to give general guidance for the design for lighting of passenger stations and surrounding site areas for the purpose of ensuring consistent lighting quality and quantity throughout the system. More specific technical electrical criteria are to be developed in later design phases.

Lighting design shall conform to CCR Title 24, Part 1, Article 1, Energy Building Regulations, CBC Title 24, and IES lighting standards including mandatory conservation requirements.

Station lighting shall promote safety by properly illuminating exitways and elements of potential hazard. Lighting and illumination levels will reflect the use of each station area by differentiating between circulation, entry, fare collection, waiting areas and platforms. Illumination will provide uniform distribution and minimize glare. Utilize direct lighting for all concourse and platform areas. Indirect lighting is not acceptable for illumination of floor areas.

Minimum average illumination under normal operation is shown in Table 3-11.

Table 3-11: Station Illumination Levels

Area	Illumination (footcandles)	Measured from
Entrances, concourse circulation, tunnels, overpasses	30	Floor Level
Concourse Waiting Areas	20	Floor Level
Ticket Gate Array and Ticket Vending	50	Floor Level
Vertical Circulation	25	Floor/step surface
Escalators, top and bottom	30	Floor Level
Platform, general	20	Floor Level
Platform Edge	30	Floor Level
Restrooms	20	Floor Level
Station Agent Booth, Ticket Office	60	Table height
Staff rooms	20	Floor Level
Other Ancillary Areas	See room data sheets	Above floor surface/ equipment surface

3.10.2 Electrical

3.10.2.1 System Requirements

Electrical systems include power supplies (high, low voltage, and emergency), normal and emergency lighting, and grounding and lightning protection. Facilities to support electrical operation of the station may include standby generators, switchboards, uninterrupted power systems, on-site power generation such as solar power generating facilities, and electrical distribution facilities.

3.10.2.2 Emergency Provisions

When normal and backup power sources are interrupted, a standby emergency supply generator will provide station power to select electrical loads connected to the 480 VAC generator bus. Standby emergency supply generator shall provide power for electrical loads such as fire protection, emergency lights, emergency signage, telecommunications systems, elevators (typically one operation to get to the floor), ventilation, station control, UPS system, and low voltage DC battery supply systems (that provide control power to high voltage switchgear, etc.). The emergency standby generator shall have fuel capacity to operate for at least 30 hours. In addition to an emergency standby generator, uninterruptable power supply equipment shall be provided for the following electrical loads:

- Emergency lighting with a minimum battery capacity of 90 minutes
- Communication and train control electrical loads with a minimum battery capacity of 4 hours.

3.10.2.3 Electromagnetic Compatibility

All electrical and electronic equipment in the station shall follow CHST Electromagnetic Compatibility Plan (EMCP) criteria for cable, grounding, equipment design, facility power, motors and controllers, equipment room locations, equipment emission and immunity limits, FCC type accepted radio equipment, and human exposure to electric and magnetic fields. More specific technical criteria will be developed and described in a separate document.

Equipment covered by EMC criteria includes:

- CHST systems equipment including for traction power, communications, and train control.
- Station equipment including fare collection, security and public safety communications, public communications including public address and telephones, operations information, passenger information, environmental control, fire detection and protection, lighting, auxiliary equipment.
- Shared communication and control equipment with other rail operators.

3.10.3 Plumbing and Drainage

General. Plumbing and drainage systems include domestic water supply, storm water drainage, sewer and waste water drainage, and fire protection water supply. Detailed plumbing and drainage requirements in stations are to be developed.

Piping. Where domestic water piping or drainage piping enters a room through an outside wall, conceal the pipe from public view. Valves shall be concealed in valve boxes not exposed to public view.

Drains. Wherever floor drains are required, floors shall be sloped a minimum of 1/8" per foot. Coordinate drain locations with architectural floor finish patterns to minimize cutting of materials.

3.10.4 Fire Detection and Protection

General. Fire protection criteria are to be developed.

Automatic Fire Sprinklers. Coordinate placement of automatic fire sprinkler heads with other mechanical and electrical equipment such as air supply and return, lighting fixtures, public address speakers, etc. Conceal pipes in public area ceilings.

Fire Suppression System. Provide an appropriate fire suppression system as required by code for specific room functions such as train control and communications rooms.

Fire Hose Cabinets (FHC). In concourse public areas, provide recessed fire hose cabinets integrated into the standard wall finish module. FHCs on platforms may be floor mounted. Provide hinged doors, clearly labeled "FIRE HOSE CABINET" with locks keyed alike. Construct from brushed stainless steel.

Fire Extinguishers (FE). Provide FEs, type and spacing as required by code, recessed into walls in public areas or surface mounted in non-public areas.

3.10.5 Noise Control and Acoustical Design

Purpose. Noise generated by the train, patrons, external sources, and building systems shall be controlled and reduced through station design. Stations shall be designed to allow for normal conversation, ensure that public announcements can be clearly understood and allow for communication during emergency conditions.

Mitigation. Appropriate mitigations shall be considered both inside the station and adjacent to the station. This may include sound absorption materials installed in under-platform areas, ceilings and walls of platform and concourse areas. Acoustical treatment in stations shall meet acoustical performance criteria as well as architectural, safety and maintenance criteria. Performance criteria include: low flammability, low smoke development, non-toxicity, low volatile organic compounds (VOC), low maintenance, and vandal-resistance, resistance to water, rotting, and odor.

Noise Barriers. When trains pass through stations, there may be some circumstances where noise levels exceed 90dBA. In order to minimize this impact, noise barriers may be required between through and stopping tracks. Perimeter noise barriers may also be required to minimize train noise impacts on surrounding buildings and communities.

Reverberation Time. For public station areas, reverberation time shall be a maximum of 1.5 seconds at 500 Hz (per THSR Station Design Criteria). Maximum station noise levels are shown in Table 3-12:

Table 3-12: Station Noise Levels

Location	Maximum Noise Level Permitted
Platform – Stopping Trains Entering and Leaving Station	80 dBA
Platform – Trains Stopped at Station	70-75 dBA
Platform – Train Passing Station	85-90 dBA
Concourse – Near Platform with train passing station	75-80 dBA
Public Station Areas – With mechanical, HVAC or other station equipment operating	55 dBA
Public Station Area – Tunnel or station ventilation operating in emergency status	70-80 dBA
Offices and Small Meeting Rooms	40-45 dBA
Control Rooms	35-40 dBA
Computer and Equipment Rooms	55 dBA
Building Plant Rooms (where this cannot be met, warning signs will require staff to wear hearing protection)	85 dBA

Note: Noise levels measured by a slow response time constant averaged over 1 second. Center of platform should be used as the reference measurement location. Noise levels due to train-generated noises are design objectives only.

3.10.6 Vibration Minimization

Ground and structurally borne vibration generated by the train and equipment will be addressed through station design. Passenger and staff comfort will be maintained and station elements designed to withstand vibration. Vibration from train operation will not be perceptible by passengers. Vibration from station equipment will be mitigated to acceptable levels. The vibration impacts to surrounding areas will be minimized.

Equipment which generates vibration will be isolated from other station elements to reduce vibration-induced fatigue of other components and equipment. All mechanical and electrical equipment will be set on isolation pads.

The maximum vibration level allowed for platforms and building plant rooms is 80 dB. Other public and non-public areas have a maximum vibration level of 40 dB.

3.10.7 Environmental Control Systems

Locations. Heating, ventilation, and air conditioning (HVAC) requirements will vary based on station type, station area weather, and other factors. Level of service will also vary within the building based on specific room requirements. HVAC may be provided in concourse areas but will not be provided on platforms except for underground stations.

Temperature Control. Temperatures for public station areas, with the exception of the platform, passenger services areas, and station operations areas will be kept between 65°F and 75°F degrees with a maximum of 65% relative humidity. The Station Control Room, ancillary areas, computer rooms, and communication equipment rooms will be kept cooler with a maximum relative humidity of 60%. Main substations, standby generators, the central air conditioning plant and AHU rooms will be kept below 100°F.

Ventilation. Ventilation will be provided in the Free, Paid and Operations areas so that positive pressure is maintained to the exterior and to the platforms.

Redundancy. Redundancy is not required for environmental control systems for public areas. Back-up mechanical HVAC systems will be provided for areas and equipment rooms that are essential to HST operations, including the Station Control Room, System Equipment rooms, and other supporting facilities. At least two chillers will be provided for the chilled water system in order to reduce the impacts of losing one of them.

Controls. Temperature and humidity shall be controlled from the Station Control Room.

Space Requirements. HVAC space requirements may include chiller room, air handling unit room, control room, and ventilation room among other spaces. Refer to Section 3.6.5.4 and Room Data Sheets for additional information.

3.10.8 Flood Protection

Site. Stations sites shall be analyzed for proximity to a flood plain or other potential sources of water infiltration. All openings into stations shall be protected to a minimum of 4'-0" above the 100 year design flood level.

Entrances. Station entrances shall be protected, as appropriate, by steps, a sloped plaza apron, or ramping up to a landing to include minimum flood protection of 2'-0" above surrounding grade level as anticipated for a 100 year flood.

Waterproofing. Portions of station facilities identified to be below the water table shall be appropriately waterproofed to prevent infiltration of ground water for the design life of the facility.

3.11 SECURITY PROVISIONS

3.11.1 Objectives

Station security is provided with the goal of protecting the station, the high-speed train system and station, system patrons, and employees. Station design will be open with unobstructed sightlines. Avoid dark or hidden areas as much as possible. Where lines of sight are broken, CCTV will be used to replace direct surveillance.

3.11.2 Security Spaces

Specific security spaces included in station facilities include a Security Office or a Police Office. Other facilities which may contribute to station security include the Station Control Room, the Platform Agent Booth and the Station Manager's Office. Staff support facilities will be shared between security and other station personnel. The types of security control provisions will be based on the type of space. Security provisions must not compromise emergency egress. Station security must not be compromised during an emergency.

Between the free and paid area, security measures may be implemented. Absent any defined security measures, a provisional space allowance should be planned for as defined in Section 3.7.4 – Fare Gates: Provision for Security Measures.

3.11.3 Security Devices and Alarms

Ancillary and building system spaces will be protected by locks and intrusion alarms. Station entrance doors and gates will be equipped with an audible alarm and be connected to the Station Control Room. Design criteria for doors, gates and locking mechanisms required for the prevention of unauthorized access to emergency exits, rooms with fixed equipment, corridors, stairwells and other controlled areas will be developed in conjunction with emergency, operations and maintenance plans. Provide the following security devices at each room:

Table 3-13: Security Devices in Stations

Station Area	Security Devices and Provisions				
	CCTV	Sensing Device	Emergency Button	Intercom	Increased Lighting
Area open to the public during system operating hours					
Station Entrance	X	X			X
Free Area	X			X	
Ticket Sales Area	X			X	X
Ticket Gates	X			X	X
Paid Area	X			X	
Public Stairs	X				X
Escalators	X				X
Elevators	X			X	X
Platform	X		X	X	X (at edge)
Public Restrooms	X (at entrance)		X		X (at entrance)
Area open to staff at all times and to the public during emergency or special circumstances					
Station Operation Office Entrances	X	X			
Emergency Stairs	X	X		X	
Controlled Access for staff only					
Cash Handling/Ticket Storage	X	X			
Station Control Room	X	X			
Station Computer Room		X			
Building Service/Core System Room Entrances		X			
End of Platform		X			

3.11.4 Station Closure

The station must be able to be fully closed and secured during the daily schedule and in case of emergency. Security gates will be used to close the station during non-revenue hours. Security gates can be key-controlled from both the inside and the outside of the station. Each station entrance will have at least one main door for use by staff to exit when the station is closed and the security gate is closed.

3.12 STATION INFORMATION

3.12.1 General Principles

The key to passenger wayfinding is logical and consistent station planning, conforming to the passenger circulation principles. Information systems shall be provided as additional support to assist passengers in finding their way to, within, and from high-speed rail stations and related facilities. Information systems shall reflect the system's commitment to universal design and passenger friendliness. The key features of station information are described in this section.

3.12.2 Signage and Graphics

Signage shall be provided throughout stations to improve way-finding and safety as well as providing general information. Signage will be visibly and logically placed to maximize effectiveness. Information provided on signage will be simple and concise. The quantity and hierarchy of signage will be considered to ensure that signage is efficient and not redundant or confusing. Other transportation systems and modes will be integrated into the signage plan. All signage and graphics shall meet the requirements of ADA, CPUC, NFPA 130 and Code of Federal Regulations Title 29, Part 1910.

Specific signage and information to be considered include: way-finding signs, informational signs, variable message signs, warning signs, maps, schedules, clocks, arrival and departure information boards, and public address systems. Additional signage may include safety signage, emergency signage, regulatory signage, room name signage, and advertising. System and station identification signage will be provided on the building exterior, at entrances, at the passenger information center, at ticket sales areas and on platforms. Room, area, and facility names will be provided for all of these facilities including door signs to rooms.

Directional signage will include the following:

- Entrances: Direction of streets, surrounding destinations, and local transfer facilities.
- Free Area: Direction of emergency egress, ticket sales, paid areas, platform and entrances.
- Paid Area: Direction of emergency egress, specific platforms, and station exit.
- Platforms: Direction of emergency egress, exit, and train movement.

Informational signage may include maps of the HST system, other transit systems, station building, neighborhood, and city, transfer information, timetable and fare information and instructions for use of station facilities.

Train information display boards will be provided along major circulation routes, in the ticket sales area, at the ticket barrier, in the free and paid areas and on the platforms. Train information monitors will be provided in waiting areas and on the platforms.

System clocks will be provided at station entrances, in the ticket sales area, in the free and paid areas and at the platforms.

Additional information will be developed at a later time. Functional signage must be clearly differentiated from advertising or art. Nomenclature, semantics, fonts, symbols, colors, layout and spacing on signage will be consistent throughout the system. Signs and graphics will have a consistent module to provide for incorporation into all stations. Illumination and power requirements for signage must be considered.

3.12.3 Public Address System

A public address system shall be provided as an auditory means for station staff to announce train arrivals, delays, security concerns and other significant passenger information. Speakers shall be installed throughout the station, including exterior approaches. Speakers shall be mounted high enough to not be readily visible but low enough to ensure voice clarity. Announcements may be made by station staff from the Station Control Room, Passenger Assistance Booth or Platform Agent Booth (if provided). Refer to the Systems and Communications chapter of this design manual for additional information.

3.12.4 Information Monitors

Video monitors shall be located throughout the station public areas to provide visual information, announcements and messages regarding train schedules, delays etc. in conjunction with the public address system information. Visual information may also include weather reports, commercial advertising or other. Monitors shall be wall or ceiling mounted, located at concourse free and paid areas and platforms. Refer to the Systems and Communications chapter for additional information

3.12.5 Customer Service Agents

Personnel staffing the Customer Service Booth, the Platform Agent Booth (if provided) or other roving staff will provide a significant service by offering face to face information to passengers when neither signage, public address nor monitors address a passenger's questions or concern.

3.12.6 Advertising

Advertising provides system revenue as well as visual interest to passengers awaiting trains. A system-wide policy will be developed to locate advertising in a consistent fashion where it will not conflict with other station information. Sizes will be standardized throughout the system.

3.13 EVACUATION FROM PUBLIC AREAS

3.13.1 General Goal

3.13.1.1 Life Safety

Life safety is an essential goal of the CHST system. Therefore, a clear and consistent methodology for passengers to quickly and safely evacuate stations in the event of an emergency is also essential. This methodology must be consistent with CHSTP operations policies and with the standards established in NFPA 130 and related safety standards. Station design must accommodate means for total evacuation of passengers and staff from within each station.

3.13.1.2 Scope

This section addresses means of evacuation from the public areas of stations. Evacuation from station non-public areas is addressed in Section 3.6.9. Firefighter's access into stations during emergencies is addressed in Section 3.1.8.

3.13.2 Causes for Evacuation

3.13.2.1 Fire

Due to the use of non-flammable building materials throughout stations and a high level of fire prevention and detection, station fires are unlikely. Nonetheless, station fires as well as train fires must be considered as potential emergencies necessitating complete station evacuation.

3.13.2.2 Evacuation Scenario

For purposes of emergency evacuation planning and station design, the evacuation scenario assumes a burning train enters a side platform station platform during the peak hour. The platform is already occupied by passengers accumulated during the 15 minutes since the previous train departed and are now waiting to board the arriving train. The train is fully occupied with passengers who must alight onto the platform. This combination of peak hour boarding and alighting passengers must be quickly evacuated from the station.

3.13.2.3 Center Platform Station

At intermediate stations, in the case of a center platform configuration, the design scenario assumes a second fully loaded train arrives on the adjacent track and, together with boarding passengers, also must be concurrently evacuated. Terminal center platform stations shall take into account the uni-directional scheduling of arriving trains and the limitations of trackwork to consider whether a second fully-loaded train, arriving concurrently at a single center platform is physically possible. If not, evacuation of a single fully loaded train with boarding passengers is sufficient.

3.13.3 Evacuation Goal

3.13.3.1 Principle

In accordance with NFPA 130 and California Building Code sections 419 and 433 (as corrected to reflect the six minute rule), adequate evacuation routes must be available to evacuate all passengers from the affected station platform (Platform Occupant Load) in four minutes or less and from the most remote point on the platform to a point of safety in six minutes or less. Once the last passenger has set foot upon a platform escalator or stair, sufficient escape routes shall be provided to enable evacuation to a point of safety within the remainder of the total six minutes.

3.13.3.2 Multiple Escape Routes

Evacuation routes shall be planned so that a passenger confronted by an outbreak of fire can turn away and make a safe escape. To achieve this goal the maximum travel distance to an escape route such as an escalator, stair, passageway or entrance shall not exceed 325 feet.

3.13.4 Evacuation Components

3.13.4.1 Scenario

The evacuation goal described above assumes the irregular train operation scenario described in Section 3.4.2 has occurred as a result of a fire and all boarding and alighting passengers must be quickly evacuated. The following factors shall be considered in emergency evacuation planning.

3.13.4.2 Peak Period

The emergency occurs during the peak 15 minutes of the peak hour at the ultimate peak design year.

3.13.4.3 Platform Occupant Load and Platform Area

One fully loaded train alighting at each platform edge is added to the peak 15 minute boarding passengers waiting on the platform. Platforms shall provide a minimum 10 square feet per occupant during emergency conditions.

3.13.4.4 Platform Egress

An egress point can be the first riser of a stair or escalator, a horizontal exit with an appropriate door or gate which exits to grade (including an exterior refuge zone from a center platform) or a fire-rated door (alongside platforms or at the ends of island platforms if a refuge zone is provided of the end of the platform).

3.13.4.5 Vertical Circulation

Only stairs and escalators may be used for evacuation between station levels; elevators are not considered for evacuation. Escalators normally moving in the direction opposite to evacuation will be remotely stopped and used as stairs. One escalator is assumed to be out of service.

Escalator Step Width:	40 inch
Fixed Escalator capacity:	1.41 people per inch per minute x 40 inches = 56 ppm
Stair capacity:	1.41 people per inch per minute

3.13.4.6 Gates

All ticket gates, oversized gates and emergency gates are available and have been opened by station staff for free, full-width (non-turnstile) passage in the exit direction.

Fare Gate capacity:	50 people per minute
Oversized and emergency gate capacity:	2.08 people per inch per minute

3.13.4.7 Walking Speeds

Horizontal evacuation on platforms:	124 feet per minute
Horizontal evacuation on concourse:	200 feet per minute
Vertical evacuation (up direction):	48 feet per minute
Vertical evacuation (down direction):	60 feet per minute

3.13.4.8 Place of Ultimate Safety

Underground Stations: The place of ultimate safety is the uncovered public thoroughfare at ground level outside the station.

Elevated Stations: Where platforms are open to the elements and the concourse is below, the place of ultimate safety may be the concourse level.

At-Grade Stations: Where platforms are located at grade level and open to the elements with concourse above or adjacent to the platform or tracks, the point of ultimate safety is a point outside the station enclosure.

3.13.5 Determining Means of Escape from Stations

3.13.5.1 Normal Operation

The platform layout planned for normal operation in Section 3.4.2 shall be considered the baseline station plan. Normal operation layout shall be tested against the six-minute evacuation standard. If the normal exiting routes are inadequate for emergency evacuation, provide additional capacity for evacuating the Platform Occupant Load (POL).

3.13.5.2 General Methodology

1. Confirm the capacity of escalators and stairs to evacuate the platform in less than four minutes as follows: POL / Platform Egress Capacity < four minutes

2. Confirm the capacity of all gates to evacuate the POL freely within six minutes or less.

3. Confirm the capacity of all evacuation elements to evacuate the platform from its most remote point to a point of safety in six minutes or less. Evacuation time considers the following factors:

- Walking time on the platform
- Walking time between platform and concourse
- Walking time on the concourse to a point of safety
- Walking time between concourse and grade level (where occurs)

Where multiple entrance/exits are planned, the longest walking distance shall be used to calculate concourse walking time.

3.13.5.3 Excessive Evacuation Time

If evacuation time exceeds six minutes, increase capacity or shorten evacuation distances, Adding emergency exit stairs is preferable to adding escalators or public stairs considering they are more economical and would be needed only in the case of emergency. Adding emergency gates is preferable to adding fare gates, considering they are more economical and would be needed only in the case of emergency.

3.14 ACCESSIBILITY

3.14.1 Scope

HST station design shall provide easy, equitable access for handicapped and disabled passengers. HST stations shall fully comply with ADA and ADAAG.

All entrances need to be fully handicapped accessible. Elevators will be utilized to provide easy access between entrances, concourses and station platforms. All gates, passenger service facilities and machines shall be fully handicapped accessible. Directional signage shall clearly indicate handicapped accessible routes. Additional guidance on accessibility including emergency egress will be addressed later phases of design.

4.0 SUMMARY AND RECOMMENDATIONS

Passenger stations for the CHSTP will include a range of facilities, designated spaces, design elements, and service amenities. This document presents design guidance for the programming and functional requirements of high-speed train stations in order to advance design so that the station's facilities and uses can be fully considered through the 30% Design level.

This memorandum addresses the following issues:

- Station Design Considerations, including design principles and factors leading to variation between stations
- Station Program Requirements, including free areas, paid areas, circulation spaces and support areas
- Station Amenities, including furniture, signage and communication and fare collection equipment
- Station Systems, including building and systems that interface with trains

The recommended station program requirements to be provided at stations are presented in Section 6.0.

5.0 SOURCE INFORMATION AND REFERENCES

1. The Manual for Railway Engineering of the American Railway Engineering and Maintenance-of-Way Association (AREMA Manual)
2. FTA /FRA 49CFR
3. California Public Utilities Commission General Order 26-D
4. CHSRA Adopted HST Station Development Policies. May 14, 2008.
5. CHSTP Design Basis Document – California High-Speed Rail Program – High-Speed Rail System Design Comparison
6. CHSTP Basis of Design Policy – California High-Speed Train Project – January 2008.
7. CHSTP Operations Guidance for Transbay Terminal, 2009.
8. CHSTP Technical Memorandum TM 1.1.2 – Design Life
9. CHSTP Technical Memorandum TM 1.1.6 – Alignment Standards for Shared Use Corridors – Specific to LA to Anaheim
10. CHSTP Technical Memorandum TM 2.2.4 – Station Platform Geometric Design
11. CHSTP Technical Memorandum TM 2.2.3 – Station Site Design Guidelines
12. CHSTP Technical Memorandum TM 4.2 – Train Service Plan – Phase 1
13. CHSTP Technical Memorandum TM 5.1 – Rolling Stock Maintenance Plan and Facility Requirements
14. CHSTP Design Criteria Draft (2004)
15. CHSTP Electromagnetic Compatibility (EMC) Plan
16. Nash, Andrew. Best Practices in Shared-Use High-Speed Rail Systems. Mineta Transportation Institute. June 2003.
17. Taiwan High-Speed Rail Station Design Criteria. December 2000.
18. Fruin, John J. Pedestrian Planning and Design. Elevator World, Inc. 1987.
19. Caltrain Design Criteria. Chapter 3 – Station and Facilities. April 15, 2007.
20. Denver Regional Transit District (RTD) Design Guidelines & Criteria. Light Rail Design Criteria. Section 5 – Station Design. November 2005.
21. Federal Aviation Administration (FAA) Terminal Design Guidelines. April 1988.
22. Long Beach Airport Terminal Space Recommendations. April 17, 2007. HOK Architects.
23. CHSTP EIR/EIS Task 1.11 Engineering Criteria Report.
24. SCRRA Design Criteria Manual. January 2003.
25. Sound Transit. Design Standards and Guidelines for Sound Transit Projects: Sounder & ST Express Passenger Facilities. January 22, 2007.
26. Singapore Land Transport Authority. Marina Line Transit Stations. Architectural Design Criteria. May 1999.
27. Amtrak Station Program & Planning Standards and Guidelines, Ver. 2.2
28. Benz, Gregory P., *Pedestrian Time-Space Concept*, W. B Parsons Fellowship Monograph, Rev. 1992.
29. NFPA 70 – National Electrical Code
30. NFPA 130 Emergency Egress Standards and Analytic Methodology
31. Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities. 2004.
32. Transit Sustainability Practice Compendium. US Environmental Protection Agency and the American Public Transportation Association. August 2009.

6.0 DESIGN MANUAL CRITERIA

6.1 STATION DESIGN CONSIDERATIONS

Design standards and guidelines for international high-speed train systems were reviewed along with Caltrain, Metrolink, and Amtrak criteria. Several stations will be served by both high-speed trains and conventional passenger trains making these standards and guidelines important. It is recognized that there will be a high degree of variability between stations due to different station locations, ridership demands, potential intermodal connections, different trip purposes, and, at existing stations, due to local land use and building codes. The following sections identify design elements to be considered at high-speed train stations. The design guidelines are considered to be a minimum standard; local and unique circumstances will be considered in each station's design.

This document provides guidance on high-speed train passenger station elements and requirements in order to develop station plans to the 30% Design level. Future design guidance will be developed to inform post-30% Design. Topics that are currently not considered but will be in future guidance include:

- Platform edges and ends
- Furniture, fixtures and equipment
- Finish materials
- Lighting
- Noise control and acoustical design
- Vibration minimization
- Security devices and alarms
- Security monitoring
- Signage and graphics
- Public address system
- Information monitors
- Advertising

6.1.1 General Considerations

These considerations are intended to assist designers in the configuration of spaces within the station envelope. Major stations' areas and facilities are described. Design and sizing of stations will consider:

- **Safety.** Safety of station patrons, train passengers, and operating personnel shall be the first priority in station design.
- **Station Size.** Stations shall provide adequate space for all essential station functions including platforms, public circulation, passenger services, station operation offices, core systems and plant rooms, and special provisions at terminal stations.
- **Design Life.** The Design Life for passenger stations is addressed in TM 1.1.2 Design Life.
- **Shared Use.** Shared-use stations require that station design serves both high-speed and conventional rail services. Shared use does not infer shared functions; at stations where multiple rail systems are sharing an enclosure, functional, operational, and support facilities for HST are dedicated and not shared with other operators.
- **Clarity.** Stations shall be organized clearly and simply. Circulation routes shall be clear and unobstructed.
- **Future Expansion.** Station design shall consider and plan for future extension and expansion as well as ridership growth where feasible. This may include increase in system reach, increase in train arrival and departure frequencies, and increase in station passenger handling capacity including emergency exiting capacity.
- **Future Modifications.** Stations design shall consider a "not to preclude" approach and provide sufficient flexibility to accommodate future updates to the programmatic requirements, within reason.

- **Context.** Each station shall be responsive to its unique physical environment and context.
- **Finish materials.** Stations shall utilize finish materials that are durable, energy efficient, and easy to maintain.

6.1.2 Architectural Principles

6.1.2.1 General

While the majority of this Technical Memorandum sets forth planning guidelines and technical requirements for CHST stations to implement, this section is intended to convey the more subjective and esoteric qualities and aspirations of station architecture. The architectural design philosophy and principles are provided to assist designers in developing station design solutions that achieve the objectives of the Authority. Architectural treatment of support facilities, maintenance depots, guideways and other ancillary facilities will be addressed in a separate document.

The Authority's Station Development policies (May 14, 2008) state that the "success of HST is highly dependent on land use patterns that….encourage high-density development in and around the HST station" and "HST stations, by their nature will be the most effective and powerful tool to create the market conditions that attract basic sector jobs to the station areas." Design excellence of CHSTP stations and facilities will attract customers and reflect the policies of the Authority.

6.1.2.2 California State Excellence Goals

The CHSTP supports the broad goals set forth by the California Department of General Services (DGS) "Excellence in Public Buildings" (EIPB) program which promotes "high-performing public buildings and a positive architectural legacy that reflects the State's commitment to excellence." (http://www.documents.dgs.ca.gov/dsa/pubs/eipb.pdf) This statement communicates the State's expectations in the building delivery process. The program seeks to produce high performing public buildings through "Excellence Goals", establishing objectives that promote design excellence, sustainability, enduring value and public benefit.

The Authority supports the state's "Excellence Goals" as a basic foundation by which the design of high-speed train stations shall be measured.

1. Architectural Excellence – Attract outstanding architects who are committed to design excellence, best practices in energy and environmental sustainability and the other goals of EIPB.
2. Sustainability - In accordance with Executive Order S-20-04, LEED certification of Silver or higher shall be provided.
3. Integrating Art into Public Buildings and Spaces – Expand the public experience with art while adding to the building's identity and enhancing the human experience.
4. Cost Effectiveness – Use performance standards, life-cycle costing, and integrated design to deliver value above the initial financial investments.
5. Universal Design – Enhance accessibility for all.
6. Safety and Security – Safe and secure from natural or man-made disasters.
7. Make a Positive Contribution to the Local Community – Buildings sited and designed to enhance the local built environment. This goal includes:
    - involving community participation
    - strengthening and revitalizing California's cities and communities
    - enhancing the livability of the community
    - supporting economic renewal
    - encouraging multiple uses of public spaces

- promoting use of public transportation
- supporting sound growth patterns
- providing convenient access for customers and employees
- reducing traffic congestion, and
- promoting improved air quality.

8. Preservation of Buildings of Historic Value – Preservation of historic buildings retains the art of architecture that has contributed to the community for decades.

6.1.2.3 System Design Philosophy

The central objective for design of the CHST system is to provide a safe, convenient, fast and efficient means of travel to the users. A secondary fundamental design principle is to present a strong, positive image of the CHSTP facilities to the citizens of California through excellent architectural design.

Given the State of California's aforementioned design excellence principles as overarching guidance, the architectural image of CHSTP stations and facilities will be of particular importance. As perhaps the nation's first high-speed rail system, the CHSTP will establish a standard of quality for many similar systems to follow. The nation and the world will be closely watching the CHSTP's architectural approach to station design and the utmost attention must be taken in producing architecture commensurate with the greatness of the State of California.

CHST stations will symbolize a new mode of travel and transportation for this nation, not unlike the great urban railway stations that have become the heart of communities throughout the world. Convenient interchange with other modes of transportation will be the catalyst in creation of successful transportation centers and development of communities into which they are to be built.

The high-speed train system will present unique challenges and architectural opportunities. High-speed rail has existed for decades in other parts of the world, but the system will present a new kind of silhouette upon California's architectural landscape; uncommonly long station buildings and frequent movement of trains will introduce an unfamiliar yet exciting visual experience. While each CHST station will be expected to integrate the functional and safety requirements within the constraints of budget and schedule, each will be expected to convey a strong individual civic character, relating clearly and strongly to its context through careful architectural design.

6.1.2.4 Architectural Station Design Principles

Uniqueness: Because each community to be served by a HST station is unique, architectural design of each station will be unique. The specific functional needs of each station will be wrapped with an architectural skin which is site-specific in scale, massing, volume and material. Although certain internal and functional elements of station design will be common to all stations, the high-speed rail station image to be presented to each community will be a carefully considered response to the context of each station site.

Design Factors: Specific purpose, context, presence and image must be defined individually for each station. Each station must respond to unique, site-specific design factors including location, alignment, existing and future neighborhood architectural and historic context, anticipated ridership, climatic variations, vehicular and pedestrian station access, multi-modal transfer, protection from the elements, passenger orientation and familiarity, wayfinding, constructability and sustainability.

Community Links: As a new focal point of the community, the planning and siting of the HST station must convey an awareness of its prominent presence. It will not seek to dominate its neighborhood but rather to be sensitive to its community and context. Connections, entrances and station access points will respond to neighboring residential, commercial or other uses.

Massing: Vertical location of platforms, concourses and entrances will be a significant factor in the massing of each station; at-grade stations with an adjacent at-grade concourse will convey a significantly different presence within an urban context than will an elevated station raised sixty or

more feet above the street. This kind of inherent programmatic difference will be a driving influence in the presence of a station and in the architectural solution.

Style: Stylistic trends in early twenty-first century architecture will not remain constant; therefore while each station must reflect current and forward-thinking innovation, it must avoid a design approach which may appear dated decades later. Station context and community concerns must be reflected in station design. Where CHST stations are to be located in established urban environments, the goal will be to transform and enhance that environment and community while protecting the neighborhood's fabric. Where CHST station sites are to be located in sites without a strong existing character or context, the goal will be to establish a strong architectural foundation for future community growth.

Image: Railway stations are a unique building type with a unique purpose. The image of a CHST station will therefore convey the function of the building through its architectural design. A railway station should look like a railway station. As gateways to the CHST system and to major metropolitan centers, stations will convey an arresting image.

Context: Care will be taken to be sensitive to the station context, recognizing that an architectural solution appropriate for a densely populated, established urban center may not be appropriate for a smaller suburban community. In many cases, subtlety and understatement may be more appropriate than exhilaration and innovation.

Local Emphasis: While every station will satisfy the functional planning criteria as stated throughout this document, architectural treatment and approach will vary commensurate with the degree of local participation. Every station will be expected to satisfy the overarching goals of design excellence while recognizing the importance of local context. At a minimum, functional stations will be enclosed in a unique but architecturally reserved skin, conveying architectural subtlety while featuring striking interior spaces. Local jurisdictions wanting their HST station to make a more dynamic and impactful "architectural statement" may choose to partner with the Authority in developing "iconic" station architecture, characterized by a sense of prominence on the site, architectural expressiveness, exhilarating passenger experience, organic or curvilinear forms, unique detailing and/or uncommonly rich finish materials.

Finish Materials: Exterior materials selected for stations will be appropriate for the specific site context while satisfying system-wide design concerns including safety, useful life, durability, low maintenance, replacement and potential vandalism. Materials will respond to the context of the site and convey stability, warmth, brightness and quality.

Lighting: The presence of a high-speed rail station at night is no less important than during daylight hours. Prudent and dynamic use of lighting will be a significant design element in a station's nighttime presence. Station interior lighting will be designed to create an inviting station presence when viewed from the exterior, while ensuring energy efficiency and satisfying sustainable design goals. Station sites, including parking, approaches, landscaping, signage and entrances must be appropriately lighted for user safety as well as for architectural effect.

6.1.2.5 Interior Station Design Principles

Station Volume: The greatness of railway stations in times past has often centered upon soaring station volumes. Similarly, upon entering a CHST station, the patron will experience a sense of exhilaration, spaciousness, openness, clarity and system identity. Entrances and concourse spaces will be generously and appropriately sized according to the specific functional needs of each station. At the same time, a striking architectural image will be established through the judicious use of vertical space and interior volume. Ceiling heights may be modulated wherever the opportunity exists. Low ceilings will be used sparingly as an intimate contrast to the vertical volumes.

Openness: Station planning and design will be founded upon uncomplicated and open concepts to facilitate free movement of passengers and staff. Adherence to principles of passenger circulation described in the following sections, particularly with respect to clear, unobstructed, well-defined, well-lighted routes for public circulation are essential to planning of public areas and passenger satisfaction.

Interior Lighting: Liberal use of natural lighting is a guiding principle for station interiors. Natural light creates drama within interior spaces as it changes constantly throughout the day. Openings which allow light into the station during the day contribute to a more dynamic station presence within the community at night. Artificial interior lighting will be used judiciously to illuminate the functions requiring task and safety lighting and differentiating between differing station functions. Light sources and placement must be attentive to the energy standards established by the State of California.

6.1.3 Functional Consistency and Variability

Elements of station design can be categorized into two classifications: functionally consistent elements and functionally variable elements. Functionally consistent elements can lead to reduced capital, operations, and maintenance costs through reduced design and construction variation, economies of scale, and simplification of operations and maintenance procedures. However, unique and recognizable stations will improve the passenger experience and encourage fulfillment of the Authority's *Adopted HST Station Development Policies*.

Functionally consistent elements include but are not limited to:

- Signage and graphics
- Passenger Information Systems
- Ticket Sales Office location and identity
- Fare collection and train boarding process
- Escalators and elevators
- Fare collection equipment
- Communications systems
- Platform minimum width and length, as addressed in the TM 2.2.4 Station Platform Geometric Design
- Station Information Office
- Platform Agent Booth
- Platform floor finish surface and edge material
- Door hardware
- Public Area lighting fixtures
- Non-public area staff and plant rooms

One key to accomplishing the functional consistency of station facilities will be the development of station-operating and passenger-handling procedures. These procedures will be developed as the planning and design process progresses.

Functionally variable elements include:

- Site layout and furniture
- Freestanding entrances, where applicable
- Concourse configuration
- Finish materials in accordance with the Project's acceptable palette
- Interior seating
- Artwork

6.1.4 Passenger Accommodation

6.1.4.1 Public Areas

Public station areas intended for passenger circulation shall accommodate forecast passenger demand for the Full Build (2035) or projected Phase I, whichever is higher under estimated peak period and emergency conditions.

6.1.4.2 Boardings

- Boardings are indicated using a subscript "B" (P_B).
- **Daily Boardings:** Design shall be based on the peak day boarding as provided in TM 4.2 Train Service Plan – Phase 1. The peak day boardings take into account seasonal and day-of-week peaking as well as possible changes in HST level of service which may impact station passenger demand.
- **Peak Hour Boardings (P_{60B}):** Ridership peaking factors to convert peak day boardings to peak hour boardings are provided in TM 4.2 Train Service Plan – Phase 1.
- **Peak 30-minute Boardings (P_{30B}):** Half of all the peak hour boardings, multiplied by a system surge factor of 1.2.
- **Peak 15-minute Boardings (P_{15B}):** A quarter of the peak hour boardings, multiplied by a system surge factor of 1.3**.**
- **Peak minute Boardings (P_{1B}):** Peak hour boardings divided by 60 and multiplied by a system surge factor of 1.5.

Table 6-1: Peak Period Boardings

Symbol	Description	Formula
P_{60B}	Peak Hour Boardings	Peak day boardings x Peaking Factor
P_{30B}	Peak 30 minute Boardings	(P_{60B} ÷ 2) x 1.2
P_{15B}	Peak 15 minute Boardings	(P_{60B} ÷ 4) x 1.3
P_{1B}	Peak Minute Boardings	(P_{60B} ÷ 60) x 1.5

6.1.4.3 Alightings

The variables in Section 6.1.4.2 only apply to passengers boarding the trains. Alightings are shown using a subscript "A" (P_A). Peak alightings (P_{60A}, P_{30A}, P_{15A}, P_{1A}) are assumed to be equal to peak boardings.

6.1.4.4 Other Station Users

It is expected that some high-speed train passengers will be dropped off or picked up at the station. The number of people who drop-off or meet HST passengers is estimated to be one-tenth of the total peak boardings and alightings. Total station occupancy also includes station staff which varies based on operating conditions and station type.

6.1.4.5 Maximum Trainloads

High-speed trainsets will accommodate between 900 and 1000 passengers. The terminal station platforms will need to be sized to accommodate surge loads. Intermediate station platforms will need to be able to safely accommodate and evacuate one full trainload of passengers at each platform edge in the event of a mechanical failure or emergency condition.

6.1.4.6 Delayed Trains

Station facilities will need to accommodate the additional passengers that will accumulate within the station when a train is cancelled or seriously delayed. Estimates will be developed for expected concentrations of passengers that will accumulate within station facilities under various delay and service disruption scenarios. The methodology to be used to analyze passenger

movement and potential delay conditions will be developed as the planning process progresses in a separate document.

6.1.5 Station Vertical Configuration

Stations can be identified according to vertical platform location, as follows:

- *Underground Stations.* Platforms are located below grade and completely enclosed.
- *At-grade Stations.* Platforms are located at-grade, typically open to the air.
- *Elevated Stations*. Platforms are supported on a superstructure above grade or passing over surface features.

6.1.6 Station Functional Types

Station functional types will influence station planning and design significantly. The most significant of these types are outlined in the following sections.

6.1.6.1 Intermediate Stations

Station design must acknowledge the operating conditions at intermediate stations since most trains will have short dwell times. Passengers will typically need to be on the platform prior to the train's arrival. In the event that boarding passengers are assigned to specific seats or cars, they will need to be provided with information about where to wait at the platform, so that they can quickly board the proper car when the train arrives. The platform will encourage distribution of passengers along its length and be a comfortable environment for passengers awaiting trains.

Sufficient platform area must be provided to allow alighting passengers to exit the train without being obstructed by boarding passengers – and without causing boarding passengers to crowd near the platform edge.

6.1.6.2 Terminal Stations

Trains will occupy terminal station platforms for longer periods of time than will be the case at intermediate stations. Terminal stations are expected to be provided with additional ancillary facilities to prepare the trains for a return trip in the opposite direction. Activities occurring on or utilizing terminal station platforms may include re-stocking and provisioning the on-board food service facility, light interior cleaning of the train and trash removal, train crew circulation to and from the train, and mechanical inspection of the train between trips. Requirements for lay-up and overnight storage at stations are defined in TM 5.1 Rolling Stock Maintenance Plan and Facility Requirements.

Requirements for passenger-handling will depend upon layover time, a function of the system operating plan. When layover times are sufficiently long, passenger boarding will begin only once all alighting passengers have exited the arriving train and the train has been cleaned, inspected, serviced and provisioned. Departing passengers may be held within the concourse areas until a predetermined time in advance of the boarding process.

There may be instances at a terminal station when arriving trains will need to make a relatively rapid departure. In these cases, it may be desirable or necessary to allow the boarding passengers to occupy the platform prior to an incoming train's arrival, in which case the platform will need to have sufficient area to accommodate the boarding and alighting passenger loads simultaneously without creating undue congestion or hazardous conditions.

6.1.6.3 Intermediate Stations with Turnback Service

Operating plans are under development that will indicate the need for selected trains to originate and terminate at intermediate stations along the route to balance the supply and demand for rail system service and capacity and to ensure effective utilization of the high-speed train fleet. These stations also may require some of the elements of a terminal station, such as spaces for train crews to wait and rest, even if relatively few trains turn there. Each of the locations in this category will need to be considered individually.

6.1.7 Sustainability and LEED

Stations shall be, at minimum, LEED™ Silver Certified. LEED certification evaluates buildings across the following categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation in design, and regional priority. Sustainability practices applicable to rail stations and facilities are discussed in the APTA Transit Sustainability Practice Compendium including materials, energy, ambient environment and health, and emissions and pollution reduction.

6.1.8 Emergency Access

In accordance with NFPA 130, the local emergency authorities will respond to a station emergency according to a pre-approved emergency plan. Emergencies may include a fire within the station public or non-public areas, a train collision or derailment, loss of station or traction power, necessity to evacuate passengers, disabled or stalled train at a platform, natural disaster, presence of hazardous materials, passenger need for first aid, earthquake or other emergency.

In the event of an emergency, the local first-responder will be summoned and will require access into any or all areas in or around the station. At least one entrance will be designated as the emergency entrance. Station design shall incorporate provisions as required by the state fire marshal and local fire jurisdiction to allow firefighter access to any and all portions of the station, i.e., dedicated firefighters' entrances, stairs or other. Station plans shall demonstrate acceptable strategies for emergency access as well as emergency evacuation.

6.2 STATION PLANNING AND PASSENGER MOVEMENT

Station planning includes determination of required capacities, floor areas, adjacencies of uses and functional connections between spaces. This section describes the types of spaces required in CHST stations, corresponding areas for those spaces, basic functions, characteristics, and interrelationships of those areas. These standards and guidelines reflect only the needs of CHST, not those of any adjacent transportation facilities or systems.

Major station spaces include but are not limited to: station entrances, free area, commercial areas, free/paid line, paid area, platforms, passenger service areas, station operation offices, core systems spaces and plant spaces.

6.2.1 Goals

The main goals in planning station spaces are as follows:

- Safety and security of passengers and station occupants
- Avoidance of passenger congestion and compliance with level of service objectives
- Flexibility to accommodate surges in demand or disruptions in train service
- Adequate emergency evacuation capacity and compliance with emergency procedures
- Simplified flow between origins and destinations within station and surrounding areas
- Provide unobstructed lines of sight and well-lit spaces
- Accessibility for disabled passengers
- Flexibility to accommodate increases in passenger demand, and changes in facilities and operating procedures
- Accommodate and encourage efficient and convenient interchange with other modes of transportation.

6.2.2 Station Size

General. Every station is comprised of public and non-public functions and shall be planned individually to accommodate the functional needs for the specific location. Basic station components include:

1. Platforms (size is a function of train length, vertical circulation and passenger circulation)
2. Public Concourse (size is a function of ridership)
3. Support Space (size is a function of staffing levels)
4. Systems and Plant Rooms (size is a function of systems equipment and plant rooms)

Platforms. Platforms are the key components for public access to trains. Platform size is a function of train length and width of escalators, stairs and passenger circulation and will generally be unaffected by ridership. Size shall be sufficient for safe circulation of passengers on platforms during normal and emergency conditions.

Public Concourse. Public station areas within the concourse and mezzanine intended for passenger circulation shall accommodate forecast ridership in the Full Build (2035) or projected Phase I, whichever is higher under estimated peak period and emergency conditions. Sizing of the public concourse and related facilities shall consider the appropriate peak period within the daily peak as specified in section 6.3 and detailed in section 6.1.4. Public spaces include concourse paid and free areas, passageways and vertical circulation elements.

Non-public Areas. Non-public station areas comprise the majority of concourse space and are generally unaffected by forecast ridership; space required for these uses is determined by operational and technical needs. Non-public areas include passenger services, operations, core systems rooms, plant rooms and terminal facilities where they occur.

Terminals. Terminal stations shall be planned in accordance with the goals, facilities and functional needs of intermediate stations while also providing space to accommodate terminal functions. Specific terminal space requirements are described in section 6.6.5 and throughout this document. Additional platforms may be required to accommodate terminal train operation needs. The special operational conditions of terminals will generally result in a larger station than the intermediate type.

Station Sites. Site conditions will influence station planning and size. Each individual site will influence placement and number of exterior entrances and organization of interior spaces. Placement of intermodal transportation connections will depend on availability of adjacent site area and optimum placement in relation to entrances. Where site conditions and passenger use warrant entrances on two sides of the trackway, dual entrances may be considered.

6.2.3 Public Zones and Passenger Flows

In order to simplify station planning and passenger movement, stations are divided into functional zones. Passenger flow through these zones is as follows:

- Passengers pass through a station entrance and into the concourse/ticket hall where information, ticketing, and basic services are easily identified and located.
- Upon obtaining tickets and current train information, departing passengers will either proceed to a waiting area or make use of station amenities within the concourse. Depending upon the station configuration and passenger-handling procedures that are being employed, departing passengers may use dedicated waiting space within the free concourse area or proceed to the paid area.
- Before the train's expected departure time, passengers will be instructed by announcements and dynamic signage to proceed to the appropriate platform (and to a specific area of the platform if the system employs reserved seats or cars) to prepare for boarding the train. If reserved seats or cars are not used, passengers will be informed about the availability of seats in each car prior to train arrival.
- When the train arrives, the arriving passengers alight, and then the departing passengers board the train.
- Arriving passengers move from the platform, through the paid concourse to the free concourse, and to the station exit. Services within the free concourse for these arriving passengers include travel and transportation information and services, and "meeting and greeting" space. At high volume stations which have short headways, segregation of

arriving and boarding passenger flows will be considered in order to minimize congestion and passenger confusion.

6.2.3.1 Level of Service

The primary performance measure that will be used to determine the adequacy of pedestrian circulation facilities within the station will be peak Level of Service (LOS), as defined by Fruin[2], which describes the peak degree of congestion, based on density, at key locations within the station. This methodology is used throughout architecture, planning and engineering to size spaces for pedestrians and is not specific to types of facilities but instead general corridors, stairways and queues.

6.2.4 Station Vertical Organization

The two primary station areas in any station are the Platform and the Concourse. These areas are typically situated on different levels but may also be at the same level. The Platform provides waiting and circulation space adjacent to the trainway. The Concourse is situated between the platforms and the entrance/exits and provides space for waiting, fare collection processes, passenger circulation and station amenities. In some cases a Mezzanine may be planned as an intermediate level to connect the Concourse and Platform levels. Generally CHST stations will be planned on two or more levels with the Concourse closest to ground level.

6.2.5 Station Platform Configuration

Stations may be planned with either center or side platform configurations, depending on numerous interdisciplinary design and operations considerations. Most intermediate stations will be configured as side platforms. The following summarizes potential platform configurations.

Center Platform. This is the operating configuration in which the tracks run alongside either side of a single platform. Passengers utilize the same circulation elements to access either northbound or southbound trains.

Side Platform. Platforms are located along the perimeter of the station and a single track is positioned adjacent to each platform. Platform vertical circulation, amenities and staff spaces may be duplicated at each platform. Side platforms are preferable where both through tracks and stopping tracks serve the station.

6.3 CONCOURSE AND MEZZANINE

The concourse is the interior area between the station entrances and platforms, including the free area and paid area. This area is the gateway to the rail service and provides passengers with information, ticketing, and waiting areas for passengers and “meeters and greeters.” Where appropriate, a mezzanine level may provide an intermediate level on which some of these passenger and staff facilities are located. This section addresses public areas of the concourse. Non-public concourse areas are addressed in a following section.

6.3.1 Concourse Layout and Design

Openness. Concourses shall be open, spacious and have a high level of visibility to optimize passenger orientation and staff surveillance.

Obstructions. Passenger facilities such as public toilets, ticketing windows, information kiosks, and all associated queues shall be located clear of primary paths of pedestrian movement.

Primary paths of pedestrian movement shall be free of columns and other obstructions.

6.3.2 Free Area

General. The Free Area is the area in the concourse where patrons may circulate freely without a ticket and where space is provided for station entrances, passenger circulation, public restrooms,

[2] Pedestrian Planning and Design. John J Fruin, Ph.D. 1987.

passenger information, and passenger ticketing. Intermediate stations will preferably provide a single free area in order to consolidate passenger amenities and staff functions within a single managed space. It will be located on the ground level adjacent to the entrances to facilitate passenger orientation upon entering the station. The space will immediately convey the dynamic image and identity of a CHST station.

Multiple Free Areas. At terminal stations and special intermediate stations where station access conditions necessitate separation of entrances and multiple free areas, free walkways will connect the concourse free areas. At stations with intermodal transfers, the location of other modes may make this infeasible and passenger ticketing and information services may have to be duplicated.

Non-HST Patron Circulation. Depending on the station site, the station may be used for site or neighborhood circulation. Where appropriate, the station free area will allow for circulation across the station and across station area tracks. This will enhance the importance of the free public space and integration of the station into station area development.

6.3.2.1 Entrances

General. Entrances provide a gateway between the station building, the station site, and the surrounding community. As such, they will be distinctively designed, clearly identifiable from either the station interior or exterior, and easily accessible. Entrances may be freestanding or integrated into surrounding development provided they are clearly identifiable as station entrances. For stations with more than one major entrance, one entrance will be designated as the main entrance and be provided with all required facilities. The other side of the station may be provided with minor amenities and ticketing provisions. A free passageway will connect secondary entrances to the primary entrance.

Location. Locate entrances wherever passengers may need to connect with other modes of transportation, e.g., adjacent to taxi drop-offs, bus drop-offs, kiss and ride, passenger parking, etc.

Number. Because entrances are also exits, the number and size of entrances must meet emergency exiting requirements. Entrances may be supplemented with emergency exit doors to provide the required exiting capacity. Stations shall have at least two entrances.

Sizing. The minimum width of each entrance is 10 feet. At least one entrance shall have a width of 15 feet. Floors directly adjacent to entrances shall be level for at least 10 feet inside and outside of the entrance. For rail passengers, especially those carrying luggage, automated sliding or swinging doors are preferable to revolving doors and provide a higher capacity for passenger flow. Large diameter revolving doors may be used. Doors shall have a minimum width of 3 feet. A minimum clear space of 2 feet shall be provided to each side of a door or group of doors. Each entrance shall have a minimum width of one half of the required egress width for the station.

Other Considerations. Entrances shall be ADA accessible.

6.3.2.2 Concourse Free Area Circulation

General. The concourse free area contains circulation space for passengers travelling between station entrances and the paid area. Primary routes of passenger movement within the free area will connect all primary entrances with one another without obstruction. Ticket sales, passenger information, public toilets, and waiting areas shall be located adjacent to main circulation paths and will be clearly visible to passengers. Passenger information within the free area includes system signage, passenger information system displays (including a prominent timetable screen displaying train arrivals and departures), and a large-scale clock.

Location. Concourse circulation will typically be located on the ground level adjacent to entrances for clarity of function for passengers entering the station.

Configuration. Wherever possible, avoid turnbacks and U-turns as passengers circulate between entrances, ticketing facilities and the fare collection line. Avoid cross flows between boarding and alighting passengers.

Sizing. Adequate width shall be provided for unobstructed horizontal circulation between entrances and the concourse paid area. Circulation width is based on peak hour passenger boardings and alightings. Net free area circulation width, C_f, exclusive of any obstructions, is calculated as shown in Table 6-2.

This circulation width shall be exclusive of other required spaces such as waiting areas, information kiosks or queues for ticket purchases. Where the primary circulation route bifurcates towards multiple exits the minimum width may be proportionate to the estimated entrance users. The overall circulation space is determined based on how the concourse is organized with respect to station entrances, passenger facilities and the paid area circulation space.

6.3.2.3 Free Waiting Areas

General. Free waiting areas provide a place for passengers and the general public to wait prior to entering the paid area or leaving the station.

Location. Waiting areas will be located so they are easily accessible but do not impede the principal circulation paths between entrances and the paid area. As some of this space is dedicated for “meeting and greeting” of passengers, locate waiting areas adjacent to primary circulation paths. Spaces will be organized so that those waiting do not impede flows for others going to and from the platforms. There may be single or multiple waiting areas within the free area. Queues for ticketing facilities may not encroach into waiting areas.

Sizing. Total area for waiting within the Free Area, W_f, shall be sized as shown in Table 6-2.

6.3.2.4 Ticketing and Station Information

General. Ticketing and station information provisions are located within the concourse free area and will be directly visible to passengers entering the station.

Ticketing. Provide space within the free area for a Ticket Sales Office and Ticket Vending Machines. Queuing areas for ticketing functions shall not encroach into other required free area spaces. Space requirements and standards are discussed in Section 6.6.2 – Passenger Service Areas. Fare collection is addressed in Section 6.7 – Fare Collection.

Station Information. Provide a staffed Passenger Information Counter within the free area as described in Section 6.6.2.4. This counter and its queue shall be located adjacent to the primary circulation routes and shall not obstruct passenger circulation. Other unstaffed information kiosks, providing written information, maps, train schedules, etc. shall be located within waiting areas and near entrances.

6.3.3 Paid Area

Defined. The Paid Area is located between the fare collection line and the platforms. It includes concourse circulation space, waiting areas, paid public restrooms, mezzanine (where occurs) and vertical circulation elements leading to platforms. Within the paid area, passengers will be able to reach all platforms. Platforms are within the paid area but are addressed Section 6.4 and in TM 2.2.4 – Station Platform Geometric Design.

Access. Access into the paid area requires a paid fare and possession of a valid ticket.

Demarcation. It is assumed that the demarcation between Free Area and Paid Area is located at the a fare collection line which employs mechanical fare gates and reads valid tickets or other fare media, but may change depending on the fare collection policy adopted. In addition to fare gates, provisional space for security measures should be included as defined in Section 6.7.4. As passengers enter the paid area, they will be able to immediately locate vertical circulation routes to the platform.

Amenities. Extensive signage and passenger information will be displayed throughout the paid area.

6.3.3.1 Concourse Paid Area Circulation

General. Direct movement between the fare collection line and platforms will be facilitated through clear sight lines and logical configuration. Connections to the platform may require

vertical circulation including stairs, escalators, and elevators (Vertical Circulation is discussed in Section 6.5.3). Waiting areas and paid area restrooms will be located within the concourse paid area but will not impede major circulation routes. Avoid turn backs wherever possible, providing direct routes between the fare line and vertical circulation.

Sizing. Adequate width shall be provided for unobstructed horizontal circulation between the fare collection line and vertical circulation leading to platforms. Circulation width is based on peak hour passenger boardings and alightings. Net paid area circulation width, C_p, exclusive of any obstructions or other required spaces such as waiting areas, is calculated as shown in Table 6-2. The overall paid area circulation space is determined by the organization of the concourse free area circulation space and passenger service facilities relative to platforms.

6.3.3.2 Paid Waiting Areas

General. Paid waiting areas provide a place for passengers to wait prior to entering a platform. Short-term seating, information screens, and waste receptacles are located in this area.

Location. Waiting areas will be located so they are easily accessible but do not impede the principal circulation paths between the fare collection line and vertical circulation leading to platforms. Spaces will be organized so that those waiting do not impede flows for others going to and from the platforms. There may be single or multiple waiting areas within the concourse paid area. Additional waiting areas may be provided on platforms but will not impede platform circulation.

Sizing. Total area for waiting within the Paid Area, W_p, shall be sized as shown in Table 6-2.

Table 6-2: Concourse Circulation Width and Waiting Area

Symbol	Description	Formula [1, 2]
C_f	Net Free Area circulation width	$(P_{15B} + P_{15A}) \div (15 \times 10$ people/ft/min)
C_p	Net Paid Area circulation width	$(P_{15B} + P_{15A}) \div (15 \times 10$ people/ft/min)
W_f	Net waiting area in Free Area	$[(P_{15B} \times 1.1) + (P_{15A} \times 0.1)] \times 14 ft^2$
W_p	Net waiting area in Paid Area	$P_{15B} \times 14\ ft^2$

[1] P_{15B} = Peak 15 minute boardings; P_{15A} = Peak 15 minute alightings

[2] at LOS B

6.3.3.3 Premium Club Lounge

General. Selected stations may include a premium club lounge to cater to business travelers and "frequent rider" customers. The facility would provide premium amenities – such as those found at airline clubs, airport business centers or Amtrak's ClubAcela.

Location. The premium club lounge would be located within the concourse paid area, close to the entrance to the platforms, and will preferably provide natural light. The facility may be operated on a subscription basis as a for-profit enterprise, an amenity included with certain classes of tickets, and/or with frequent traveler status as a prerequisite.

Designated Stations. Full build-out terminal stations including San Francisco Transbay, Sacramento, Los Angeles, Anaheim and San Diego.

Size. 600 sf minimum.

6.3.4 Public Restrooms

General. Provide public men's and women's restrooms within both the concourse free area and the concourse paid area at terminal stations. Provide restrooms only within the concourse free area at intermediate stations. Additionally, provide two unisex restrooms within the paid area for the disabled and special needs passengers at each terminal station. Facilities and access shall conform to ADA requirements, state, and local codes.

Location. Locate public restrooms adjacent to main circulation routes. Entries will be clearly visible from circulation routes.

Size. Restroom facilities shall be based on projected occupant loads. The minimum occupant load for the facility will be based on applicable code requirements.

A janitor room will be provided adjacent to every set of public restrooms.

6.3.5 Commercial Spaces

General. Allocations for commercial space are not dictated by this document as such spaces are not necessary for high-speed train operation. Station design shall reflect the Authority's *Adopted HST Policy (May 2008) High Speed Train Station Development Policies* (http://www.cahighspeedrail.ca.gov/highspeedtrain_stationdev_policies.aspx) which encourage a high density of population, jobs, commercial activities, entertainment and other activities around stations. Station shall be planned not to preclude future addition or inclusion of commercial spaces.

Size. It is likely that passenger amenity services will be provided at stations. In order to not preclude addition or inclusion of these spaces, a standard assumption for passenger amenity space can be used to advance station design as shown in Table 6-3.

Table 6-3: Preliminary Passenger Amenity Space Allocation

2035 Daily Boardings	Passenger Amenity Space
Less than 5,000	3,000 sf
5,000-10,000	6,000 sf
More than 15,000	10,000 sf

Location. If commercial space is provided in the free or paid area, it will be located close to major passenger circulation routes or waiting areas. Commercial spaces and the patrons they attract shall not impede high-speed train passenger flow.

Services. Routes to supply commercial spaces will be different from passenger circulation routes.

6.4 PLATFORMS

The primary function of station platforms is the boarding and alighting of trains. Platforms shall be open with high visibility. Columns shall be limited in size and in quantity. Corners, recessed areas and other areas which may be used for hiding will be minimized.

Access from the concourse will be arranged to encourage distribution and collection of passengers along the entire platform length.

6.4.1 Platform Geometry

Platform geometry is discussed in TM 2.2.4 Station Platform Geometric Design. Topics addressed include:

- Platform configuration
- Platform length
- Platform width
- Platform cross slope
- Platform longitudinal slope
- Platform curvature
- Platform height
- Track centerline to platform dimension
- Platform edge to train gap
- Setback of obstructions from edge of platform
- Under platform refuge area
- Platforms adjacent to through tracks

  OCS poles on platforms.

6.4.2 Platform Capacity

Width: Since the platform length is a fixed function of vehicle length, the width of the platform must accommodate the predicted volumes of passengers boarding and alighting from trains during normal and irregular operation. Minimum platform widths for center and side platforms are indicated in T.M. 2.2.4. Platform width shall be the larger of the minimum platform width in TM 2.2.4 and the platform width as required by the platform occupant load.

Occupant Load: Adequate platform capacity must be confirmed by first calculating the maximum Platform Occupant Load (POL), The POL is the maximum number of passengers who will gather on the platform during the interval immediately following the departure of one train and the arrival of the next during the peak hour.

Irregular Operation: During normal operation, passengers will alight in accordance with estimated peak hour flow. However, there may be causes (mechanical or operational) for all passengers travelling in a fully-loaded train to disembark at any station. These passengers will detrain onto a platform already occupied by peak hour passengers waiting to board. At intermediate stations, maximum platform occupant load during irregular operation therefore will be one full train per platform edge plus boarding load in peak or non-peak direction. At terminal stations, maximum platform occupant load during irregular operation will be one full train plus boarding load in peak direction.

Emergency Evacuation: This irregular operation scenario is also the basis for emergency evacuation of the platform occupant load which is described in Section 6.10.

Minimum Platform Area: The platform shall be sized to accommodate the POL allowing 25 ft^2 per boarding passenger for passengers to circulate and wait during the peak (walkway LOS B). Upon train arrival the addition of alighting passengers on the platform may result in a temporary LOS C for a short duration. Minimum platform area shall be exclusive of the 2'-0" safety edge strip, platform obstructions such as escalators, stairs, columns or other fixed elements.

6.4.3 Weather Protection

Canopies: Canopies shall be designed so that they can be provided along the entire length of the platforms and extend transversely from the outer wall of the platforms to at least 12" beyond the platform edge. Canopies shall be designed to protect passengers from rain and sun but are not required over passing tracks or stopping tracks. Coordinate canopies with the overhead catenary system (OCS). Actual longitudinal extent of canopies will consider ambient climatic conditions and other factors.

6.4.4 Train Stopping Position

It is assumed that both 200m and 400m trains will be operated from commencement of system operation. Platform finishes, equipment and signage will therefore reflect the use of both shorter and longer train lengths.

6.5 STATION CIRCULATION

6.5.1 General

Effective station planning provides passengers with clear circulation patterns, as consistent as possible from station to station, in order that passengers are able to quickly and easily make their way through the CHST system. Station circulation spaces include passenger walkways, elevators, escalators, stairs, and ramps, as well as emergency routes and non-public corridors. Access and circulation shall be simple, obvious, and comfortable, recognizing many passengers will be unfamiliar with travelling on a high-speed rail system.

6.5.1.1 Basis for Circulation Sizing

Generally, station passageways and other circulation spaces will be sized based on peak period flows during normal station operations. Under these conditions, facilities shall be designed to a Fruin LOS B or better for walkways and concourse spaces and be in compliance with ADA and

NFPA 130 requirements. Where space is constrained by physical conditions that cannot be mitigated cost-effectively, high-speed train facilities may be designed for a peak LOS C as approved by the Authority. If both NFPA 130 and ADA address an issue, the more restrictive of the regulations shall be followed.

Total peak hour pedestrian volume will be assigned among all circulation in the station. Passageways shall have a capacity at least equal to the capacity of any stairs and elevators that feed it. Corridors leading directly to/from platforms shall be sized to accommodate the expected surge loadings of boarding and/or alighting passengers.

6.5.1.2 Circulation Principles

Circulation patterns shall consider the following:

- **Right-hand rule**: Observe right hand flow for pedestrian circulation.
- **Cross Flows**: Avoid cross flows wherever possible.
- **Dead ends**: Avoid dead end conditions wherever possible.
- **Obstructions**: Columns, queues, kiosks, equipment, etc. shall not encroach into circulation routes.
- **Directional travel**: Circulation routes and station layouts shall minimize changes in direction.
- **Visual orientation**: Circulation routes and station layouts shall facilitate passenger orientation by means of placing each sequential stage of circulation (ticket gates, escalator, platform, etc.) in clear view of the current stage.
- **Decision Points**: Where there is a need to make a directional decision, avoid the necessity for passengers to make multiple decisions at a single location.
- **Safety**: Avoid concealed corners or recesses which may be used as hiding places. Passengers' perception of safety is a fundamental system requirement.

6.5.1.3 Space Allocation

Circulation space allocation shall provide for the following needs:

- **Width:** Provide sufficient width to accommodate passengers walking at average speeds as specified in the following sections.
- **Luggage:** Provide additional circulation space where passengers may be travelling with luggage, strollers, bicycles, etc.
- **Queuing:** Provide space for passengers to queue at circulation elements per Table 6-4. Do not overlap queues or encroach into primary circulation routes. Due to the fact that escalators will be reversible, unobstructed queuing space shall be allocated at both the top and bottom of every escalator.
- **Run-offs:** Allow an additional 10' distance beyond escalator queuing distance to allow for passengers to move away from passenger circulation elements and make decisions without obstructing other passengers.

Table 6-4: Queuing Distance Requirements

Element	Dimension (min.)
Escalator (top and bottom from working points)	15'-0"
Stair (top and bottom from first tread)	15'-0"
Elevator Entrance	8'-0"
Ticket Gates, both free and paid sides	20'-0"
Ticket Sales Windows	20'-0"
Ticket Vending Machines	8'-0"

6.5.1.4 Platform Access

Platform access will be located and designed to minimize platform travel distance where feasible.

6.5.1.5 Non-public Circulation

Where possible, separate non-public circulation routes for station and train staff, goods and supplies, and refuse collection.

6.5.2 Horizontal Circulation/Walkways

6.5.2.1 General

Adequate horizontal circulation width is essential to achievement of the general circulation principles listed in the preceding section. Horizontal circulation width provisions are based upon accommodating the flow of a given number of passengers during the peak minute, occupying a given width and walking at a given average speed.

6.5.2.2 Constraints

Horizontal circulation may be constrained by walls, barriers or platform edge as in a passageway, platform or corridor, or it may be unconstrained as in an open concourse or mezzanine. Where passageways are constrained, extra width must be added to account for a "buffer zone" which is a distance from which people tend to stay away from vertical surfaces when walking.

6.5.2.3 Passageways

Calculated Width. Minimum net width of any passageway shall be calculated on the basis of the sum of the peak 15 minute boarding and alighting passenger flows.

Passageway width may be calculated based upon LOS B horizontal circulation unit capacity (10 people per foot per minute) during peak minute surges as shown in Table 6-5.

Table 6-5: Passageway Width Calculation

Symbol	Description	Formula [1, 2, 3]
Pu	Unconstrained Passageway width	$(P_{15B} + P_{15A}) \div (15 \times 10$ p/ft/m)
Pc	Constrained Passageway width	Pu + B

[1] P_{15B} = Peak 15 minute boardings; P_{15A} = Peak 15 minute alightings

[2] at LOS B,

[3] B = Buffer Zone: 1'-6" for space adjacent to each wall, barrier or railing, 2'-0" at platform edge except in cases when the train remains at the platform edge such as during emergency train evacuation

Minimum Width. Provide the greater of the calculated passageway width and minimum passageway widths as shown in Table 6-6.

Table 6-6: Passageway Width Minimums

Element	Dimension
Public areas	16’-0” preferred minimum
Public areas with unidirectional movement	6’-0” absolute minimum
Public areas with bidirectional movement	8’-0” absolute minimum

Equivalent Capacity: Passageways shall have a capacity at least equal to the capacity of any stairs and escalators that feed it. Passageways leading directly to/from platforms shall be sized to accommodate potential 50% surge loadings of boarding and/or alighting passengers.

6.5.2.4 Corridors

At non-public spaces, corridor width connecting service and plant rooms shall be no less than 3’-8” clear width or as determined by building code. Corridor width shall consider access needs for installing or replacing equipment.

6.5.2.5 Pedestrian Bridges and Tunnels

Minimum width of pedestrian bridges and underground tunnels shall be calculated in the same way as described in Passageways above. Natural light shall be introduced into bridges.

6.5.2.6 Moving Walkways

Where continuous horizontal concourse or passageway circulation distances exceed 400 feet, the use of moving walkways may be considered.

6.5.3 Vertical Circulation

6.5.3.1 Planning Principles

Primary Mode. Provide escalators as the primary mode of vertical circulation to accommodate normal peak period boarding and alighting passenger flows within station public areas. Elevators may not be utilized as the primary mode of station vertical circulation.

Secondary Mode. Provide stairs in addition to escalators as required for emergency evacuation. Refer to Section 6.10 for means of escape during station evacuation.

Pairing. Stairs will be combined with escalators where space allows as an alternative to escalators in the case of overloading, emergency, or maintenance.

Escalator Alternative. Provide at least one stair between levels for passengers who prefer not to use escalators.

Right-hand Flow. Stairs will generally be located to the right of a single escalator for a passenger preparing to descend. When stairs are adjacent to two escalators, the stairs will be located between the escalators. If the stairs are wider than 15 feet, the stair may be divided and moved to the outside of the escalators.

Orientation. Stairs and escalators shall be oriented to direct passengers towards their destination and avoid U-turns.

Slope. Where stairs are paired with escalators, the slope of the stairs shall match the slope of the escalators.

Future Stair Replacement. Stairs shall be designed so that they may be replaced by escalators if demand requires in the future, if feasible. This includes the stair support structure and space allocations for escalator operational elements.

Vertical Distance. Where vertical circulation is to be provided in excess of that required for peak flows, provide an escalator for upward flow wherever the vertical travel distance exceeds 10’-0”. Provide an escalator for downward flow wherever the vertical travel distance exceeds 25’-0”.

6.5.3.2 Escalators

Quantity. Escalator quantities vary by station and demand. Provide at least one extra escalator between concourse and platform levels as a backup during escalator maintenance.

Queuing Distance. Refer to Section 6.5.1 for escalator queuing requirements.

Runoff Space. Provide 10'-0" run-off distance beyond escalator queues to allow passengers additional time and space to move away from the escalator and make directional decisions without obstructing other passengers.

6.5.3.3 Public Stairs

Quantity. Provide stairs in addition to escalators where required to accommodate NFPA 130 emergency egress conditions. Refer to Section 6.10 for emergency evacuation criteria.

Width. Stairs required for emergency evacuation shall provide exiting capacity as required to supplement the escalator emergency capacity. Minimum public stair width shall be as required by NFPA 130 or in Table 6-7 (whichever is greater).

Table 6-7: Stair Width Minimums

Element	Minimum Width
Stairs next to escalators	6'-0"
Platform stairs	6'-0"
Stair-only entrances	8'-0"
Emergency stairs	6'-0"

Configuration. Public stairs used during normal operation will run in a single direction between levels. Stairs treads, risers and related details shall conform to all applicable state and local building codes.

Emergency stairs. Provide emergency stairs where escalators and stairs provided for normal operation are insufficient for emergency evacuation of the station. Emergency stairs shall be easily accessible from public areas but shall not be used during normal operation.

6.5.3.4 Non-Public Stairs

Stairs within non-public areas shall conform to state and local building codes.

6.5.3.5 Ramps

Ramps may be utilized where there are small changes in elevation or for wheelchair access. Ramp width follows horizontal circulation requirements and shall comply with ADA Accessibility Guidelines. Ramps may be appropriate vertical circulation instead of a small number of stairs.

6.5.3.6 Passenger Elevators

General. Elevators will be provided and designed for disabled patrons, patrons carrying large luggage, strollers, bicycles, stretchers, and the movement of supplies. Wherever access to the platform requires a change of level, an elevator is required.

Quantity. At least one elevator shall be provided to connect each station level. Space shall be provided for the future addition of an additional, redundant passenger elevator between station levels. Two or more elevators may be required initially at terminal stations in order to accommodate passenger flow requirements, especially passengers with luggage.

Location. Where possible, elevators between concourses and platforms will be located near the center of the platform. Where Platform Agent Booths are provided, elevator doors shall face the Platform Agent Booth and not the platform edges.

Queuing. Refer to Section 6.5.1 for elevator queuing requirements.

Emergency Egress. Elevators will not be included in the calculation of platform egress capacity and will not contribute capacity for pedestrian movements within the station.

6.5.3.7 Service Elevators.

General. Provide at terminal stations only for movement of goods, refuse and equipment between station levels for train inspecting, cleaning, restocking and repairs. Passenger elevators shall not be used as service elevators.

Number. There shall be one service elevator serving each platform at terminal stations. Provide service elevators at intermediate stations only where it is anticipated there will be frequent movement of goods or equipment between the non-public areas and platforms. Provide a service corridor either beneath or above track level connected to the non-public station areas.

Capacity. Provide minimum 3000 pound capacity hydraulic service elevators.

6.6 NON-PUBLIC/ STATION SUPPORT AREAS

6.6.1 General

This section pertains to non-public areas of the station required for the operation and maintenance of the station and the system. These include passenger service areas, station and system operation offices and other ancillary spaces including maintenance and building services.

Size. Refer to Room Data Sheets for minimum dimensional requirements for non-public areas. Room sizes and numbers may vary between stations depending on the station's location, type and function. Where room areas and/or heights are not indicated, provide a reasonable amount of space anticipated for each specific station.

6.6.2 Passenger Service Areas

6.6.2.1 General

Passenger service spaces provide services directly to station patrons. As such, they must be adjacent to station public areas and preferably located at ground level. Many of these spaces will be consistent throughout the system in order to provide continuity and familiarity to passengers. These spaces shall conform to accessibility requirements. The following is a non-exhaustive summary of these spaces.

6.6.2.2 Ticket Sales Office

Function. At the ticket sales office, passengers are able to buy tickets directly from station staff. Other ticketing transactions may also be conducted including refunds, ticket adjustments, or retrieval of reserved tickets.

Location. One secure ticket sales office shall be provided at each station concourse free area between the public and non-public areas and be easily visible from station entrances. In the event that a station provides more than one Free Concourse, a second ticket sales office may be required only if warranted by substantial patronage. Access shall be via a secure corridor, through a security door with viewing panel.

Window Quantity. All stations shall provide a minimum of two ticket windows to accommodate ticket clerk shift changes. Total ticket windows, if more than two are required, shall be provided to meet peak passenger demand as follows:

Ticket windows = $(P_{60B} \times A) \div (B \times C) = P_{60B} \div 600$

A = Percentage of P_{60B} making ticket window transactions (assume 15%)

B = Tickets sold in each ticketing transaction (assume 1.5)

C = Hourly rate at which transactions are processed per ticket window (assume 60)

The formula above assumes approximately 80% of all peak hour passengers will purchase tickets at the station, of which 20% will make their purchase at the ticket window in lieu of the ticket vending machines. The number of windows will be rounded up to the nearest whole number. At least one ticket window space will accommodate disabled passengers.

Office Size. Each window shall be minimum 5'-0" wide. Provide a minimum of 75 ft^2 of ticket office area for each window. Refer to Section 6.5.1 for queuing distances at ticket windows. Refer to directive drawings for typical ticket windows.

Related Provisions. Ticket Vending Machines (TVMs) shall be located near the Ticket Sales Office and within view of the ticket office queuing area. Requirements for TVMs are outlined in Section 6.7.3 Ticket sales administrative offices and other ticketing-related offices shall be adjacent to these facilities.

6.6.2.3 Passenger Service Booth

A standard system-wide freestanding booth situated adjacent to the fare gate array between the concourse free area and paid area. Design criteria to be developed.

6.6.2.4 Passenger Information Counter

A standard system-wide freestanding counter situated within the concourse free area. Design criteria to be developed.

6.6.2.5 Lost and Found

Function. Space is used to store and manage passenger's lost items as well as to collect and return these items to and from passengers.

Location. Concourse free area, adjacent to the Station Manager Office.

Provisions. At intermediate stations, minimum area 80 ft^2. At terminal stations, minimum area 120 ft^2. Provide door opening into the Concourse free area as well as an interior door connecting with the Station Manager's Office. Provide storage shelving and an internal passenger service counter.

6.6.2.6 Police Office

Function. Selected stations will provide an office for police responsible for station surveillance, passenger interface and railroad security.

Location. Located near the station entrance, between the public and non-public areas. This office will be located so that it can be open to the public area with a counter. Locate adjacent to the security office.

Provisions. Minimum area 160 ft^2. Some stations may require holding cells and/or canine support facilities as well.

6.6.3 Station Operation Offices

6.6.3.1 General

These back-of-house areas are offices and other spaces which have no public contact. These spaces include station administration offices, ticketing back offices, station control and operations spaces, train crew spaces, and maintenance spaces. Rooms and spaces will be arranged into suites according to function and have separate non-public accesses. Access control will be appropriate to each function. It is preferable for these offices to be located at concourse ground level unless otherwise indicated. The following is a non-exhaustive list of these spaces.

6.6.3.2 Station Administration Office

Function. Station administrative tasks are performed in this space. Some staff may have dedicated workspaces while others may share.

Location. Adjacent to the Station Manager's office.

Provisions. Minimum area 100 ft^2 per assigned staff.

6.6.3.3 Station Manager's Office

Function. This serves as the office for the Station Manager.

Location. Adjacent to other non-public administrative offices.

Provisions. Minimum area 270 ft^2.

6.6.3.4 Training and Meeting Room

Function. This room will be included in selected stations and is used for staff meetings, staff training and emergency command.

Location. Adjacent to the Station Administration Office.

Provisions. Minimum area 200 ft^2.

6.6.3.5 Station Control Room

Purpose. The Station Control Room is where passenger circulation, ticketing, fare control, security, and building service operations are monitored and controlled. Local train operation, traction power, signaling, and communication may also be temporarily controlled from this room in the event that the Central Control Facility (CCF) is not operational.

The Station Control Room may also function as an incident response command center. This will be the place where first responders would coordinate activities with station personnel in the event of an emergency or security incident.

Location. Designers need to be familiar with the operating plan and coordinate their efforts with the systems designers to determine the appropriate location and configuration of any such facilities at CHST stations.

Provisions. For initial planning purposes, provide a minimum area of 1,100 ft^2. Provide access flooring for underfloor cable routing. Layout for the Station Control Room will be in accordance with a system wide standard to be developed.

6.6.3.6 Station Computer Room

Function. The Station Computer Room houses the servers that are needed in order to operate the ticketing and station operation systems.

Location. Adjacent to the Operation Maintenance Office.

Provisions. Minimum area 500 ft^2. Controlled heat and humidity and a link to the Uninterrupted Power Supply (UPS).

6.6.3.7 Ticket Administration Office

Function. Used for non-public administrative ticketing functions

Location. Adjacent to the Ticket Sales Office.

Provisions. Minimum area for the Ticket Administration Office 160 ft^2. Provide cash handling and ticket storage in an adjacent secure room.

6.6.3.8 Cash Handling and Ticket Storage Room

Function. Used for processing cash received from ticket sales and for storage of blank tickets.

Location. Adjacent to the Ticket Administration Office. A secure route shall be provided from this area to a place where money and tickets can be transferred to money transport vehicles.

Provisions. Minimum area for cash handling and ticket storage 260 ft^2 including a partitioned 60 ft^2 for ticket storage. A safe will be provided in this room for temporary storage of tickets and cash.

6.6.3.9 Security Office

Function. This office provides a control center for station security.

Location. The Security Office will be located adjacent to the Station Administration Office and the Police Office.

Provisions. Minimum area 160 ft^2 .The office will have video screens to monitor the station area CCTV.

6.6.3.10 Facility Maintenance Office

Function. Building services administration and maintenance.

Provisions. Minimum area 330 ft^2.

6.6.3.11 Operation Maintenance Office

Function. Administration work and parts/equipment storage for the system operations and engineering staff.

Location. Accessible to the loading dock. Operation Maintenance Offices are required at terminal stations and other selected stations.

Provisions. Minimum area 1,100 ft^2.

6.6.3.12 Staff Break Room

Function. For station staff on break.

Location. Grouped with other staff functions.

Provisions. Minimum area 200 ft^2 or as required to provide 25 ft^2 per staff within a typical shift. Provide basic kitchenette facilities within the Break Room. At intermediate stations provide staff lockers within the Staff Break Room for storage of personal items.

6.6.3.13 Staff Locker Rooms

Function. Personal storage and showering for male and female staff during shift.

Location. At Terminal Stations only, grouped with other staff functions.

Provisions. Size as required for estimated staff numbers during a typical shift. Provide individual lockable lockers and benches for changing clothes. Provide shower rooms separated from the locker area. Size and quantity to be determined by California Building Code.

6.6.3.14 Staff Restrooms

Function. Men's/Women's toilets dedicated for staff in addition to public restrooms and in accordance with the building code.

Location. At terminal stations only. Staff Restrooms will be located in the Station Operations Office area and adjacent to the Staff Locker Room and Staff Break Room. At intermediate stations staff will use Public Restrooms.

Provisions. Size and fixture quantity to be determined by California Building Code.

6.6.3.15 Platform Agent Booth

A standard system-wide freestanding booth situated within the platform. Design criteria to be developed.

6.6.3.16 Transportation Agency Offices

Local or regional transportation agencies may be interested in having offices within stations. Inclusion and sizing of this space would vary by station and will be determined based on coordination with local agencies.

6.6.4 Ancillary Spaces

Other station ancillary spaces may include the following.

6.6.4.1 Refuse Storage Room

Function. Space to store an appropriate volume of recycling and waste produced within the station during a maximum three-day period between pickups.

Location. Refuse storage will be located where collection trucks can collect, away from public areas and outside of the station where feasible.

Provisions. Minimum area shall be 150 ft^2 or as required to accommodate current recycling requirements with flexibility to accommodate future changes. Terminal stations will require additional area. Accommodate waste generated over three days on trains, within station, and by commercial establishments within the station. Provide a hose bibb and floor drain.

6.6.4.2 Cleaning Supply Rooms

Function. Storage space for cleaning supplies.

Location. Adjacent to the Concourse free area, the Concourse paid area and the Platform. Cleaning supply rooms shall also be located near each set of toilet facilities.

Provisions. Minimum area 80 ft^2 . Provide a janitor's sink, mop and broom racks.

6.6.4.3 Station Storage Rooms

Function. General storage

Location. Adjacent to the Concourse free area, the Concourse paid area, and on the Platform.

Provisions. Concourse minimum area 150 ft^2 . Platform minimum area 100 $ft^{2.}$

6.6.4.4 Landscape Maintenance Storage Room

This room will have space for landscaping tools and supplies and basic work. It will have direct access to outdoors.

6.6.4.5 Miscellaneous Rooms

- Staff equipment storage: 60 ft^2
- Consumables storage: 60 ft^2
- Advertising storage: 60 ft^2
- Materials storage: 60 ft^2
- Small materials storage: 60 ft^2

6.6.5 Terminal and Turnback Station Operations Facilities

Provide space to support the cleaning, re-stocking, provisioning and preparation of trains prior to turning at terminal stations or other stations based on the operations plan. This may also include additional area for train crews, on-board security staff, cleaning crews, and mechanical crews (including break rooms, locker rooms, ready room, train crew sleeping quarters, and/or ticket receiver's office).

6.6.5.1 Train Crew Support

Spaces required for train crews at terminal stations, which may include shift changes and waiting spaces while trains are being turned, include the following:

- Team Leader Office. 120 ft^2
- Shift supervisor Office. Includes space for four shift supervisors. 400 ft^2
- Administrative Support Office. Room for one support staff. 100 ft^2
- Train Crew Restroom. 100 ft^2
- Supervisor Lockers/Shower. 200 ft^2
- Ready Room. 400 ft^2
- Train Crew Lockers/Showers. 200 ft^2

6.6.5.2 Platform Maintenance Operations

Spaces required for minor maintenance and inspection of the trains and platform include the following:

- Gang Foreman Office.100 ft^2
- Car Inspector Office. Includes space for two car inspectors. 120 ft^2
- Cleaners' room. One 120 ft^2 room shall be located on each platform. Each room will accommodate two cleaners.
- Maintenance lockers, showers and restrooms. 200 ft^2
- Refuse Rooms. Three 75 ft^2 refuse rooms will be located at platform level.
- Maintenance Equipment Storage Lockers. Three 160 ft^2 maintenance equipment storage lockers will be located at platform level, distributed along the length of the platform under escalators or stairs for tool and miscellaneous storage. Provide water and power.
- Cleaning machine storage and charging 660 ft^2
- General Storage Lockers. 400 ft^2 total area, distributed along the length of the platform, under escalators or stairs where possible, for restocking of trains.

6.6.5.3 Commissary Requirements

Spaces required at terminal stations to provide for commissary service on the high-speed trains include the following:

- Commissary Office.120 ft^2
- Food Store Room. 800 ft^2, accessible from the loading dock
- Commissary Lockers/Shower/Restroom. 350 ft^2

6.6.5.4 Turnback Stations

Particular intermediate stations may be operated as turnback stations. Provide these stations with crew waiting and changing spaces.

6.6.6 Station Building Service and Standard Plant Spaces

Potential systems to consider include but are not limited to: environmental control, electrical, fire protection, and plumbing and drainage. Station design shall accommodate the building systems and meet the requirements of applicable codes. Additionally, facilities necessary to meet LEED Silver standards and corresponding efficiency and energy use standards shall be included, as determined by the designer.

Access and hoisting provisions shall be provided for installation and future replacement of station equipment. Ceiling height in equipment rooms shall be 16'-0" minimum to permit equipment placement and overhead utility routing.

6.6.6.1 Environmental Control

Spaces for the environmental control system may include the following:

- Chiller Room
- Air Handling Unit (AHU) Room
- Ventilation and Exhaust Room
- Smoke Extract Room
- Tunnel Ventilation Room
- Motor Control Center Room

6.6.6.2 Electrical System

An external substation Facility Power Substation will be required on the station site for the purpose of providing normal, backup, and emergency standby power to the station. Substation will be located within a 10,000 ft^2 fenced area that contains high voltage (HV) switchgear, HV transformers, emergency generator, and a fuel storage tank. The generator and adjacent fuel tank shall be a minimum of 25'-0" from any station structure and separated from adjacent properties. Provide service vehicle access.

Spaces for the Facility Power system within the station may additionally include the following:

- Low voltage (LV) Distribution, Transformation, and Emergency Power Source (i.e., UPS) within Decentralized Electrical Room – 900 ft^2. Two rooms required; one room located at each side of station.
- LV Batteries (within Dedicated Battery Room. – 200 ft^2. Two rooms required; one room located at each side of station.

6.6.6.3 Fire Protection

Spaces for the fire protection system may include the following:

- Fire Pump Room
- Fire Water Tank Room
- Clean Gas Room

6.6.6.4 Plumbing and Drainage

Spaces for the plumbing and drainage systems may include the following:

- Sewage Equipment Room
- Sewage Treatment Plant
- Sewage Control Room
- Water Tank Room
- City Water Pump Room

- Sump Pump Room
- Ejector Room

6.6.6.5 Emergency Generator Room

An external Generator Room will be required on the station site for the purpose of providing emergency standby power to the station. See Section 6.6.6.2 – Electrical Systems.

6.6.7 Railroad Systems Facilities

Facilities needed for HST systems are addressed in other technical memorandums, specifically TM 3.3.2 Train Control Site Requirements and TM 3.4.2 Communication Site Requirements. Potential systems to consider include but are not limited to: communications, signaling systems, traction power, and rail infrastructure maintenance. Station design shall accommodate the systems and operational requirements and meet the requirements of applicable codes.

6.6.7.1 Train Control and Communications System

Spaces for the train control and communications system may include the following:

- Train Control and Communication Room – 1,280 ft^2
- Communication Battery Room – 160 ft^2
- Third Party Communications Room -- 160 ft^2

6.6.7.2 Other HST Facilities

Spaces for other HST facilities may include the following:

- Electric Switch Room – 160 ft^2
- Battery Room – size to be determined

6.6.8 Service Access

6.6.8.1 General

Terminal stations require service access between all platforms, the back-of-house areas of the station, and the station loading zone. Ideally, these access routes will not cross circulation routes within the station public areas. These corridors will be used by station staff and maintenance personnel and will not be accessible to the public.

6.6.8.2 Service Elevators

At terminal stations, service elevators separate from the passenger elevators shall be provided to each platform, connecting with a service corridor that passes above or below the platforms and provides direct non-public access to the station's back-of-house facilities. It will be desirable to standardize the location of these service elevators at all high-speed train stations (i.e., at the north end or south end of the platforms), to facilitate train provisioning and servicing. This will require coordination with the trainset design and the developers of the overall operating plan.

6.6.8.3 Service Corridors

Certain station-related service corridors, such as the ones linking the ticket office with the loading zone, which will be used for handling ticket revenue, will be kept separate from service corridors serving the retail and commercial zones of the station. Concrete floors shall be hardened wherever cash carts will be moved.

6.6.8.4 Loading Zone

The station loading zone and service entrance will be sized as appropriate for each station to accommodate station-related deliveries, ticket revenue handling, trash compacting and collection for the entire station, delivery of on-board services supplies (at terminal stations), police and security-related access, and deliveries to retail concessions within the station. Loading zones and related functions will be separated from the main station entrances and circulation patterns to prevent disruption of pedestrian and vehicular flows.

6.6.9 Evacuation from Non-Public Areas

6.6.9.1 General Goal

In the event of an emergency, a safe means of egress shall be provided for staff from non-public areas including operations, systems and plant areas. Refer to Section 6.10 for related emergency station evacuation criteria.

6.6.9.2 Maximum Distance to Exits

The maximum walking distance to a means of escape shall not be more than 130 feet when there are multiple means of escape. When there is only one escape route, the maximum walking distance to a means of escape shall not be more the 65 feet. Any dead-end corridors shall not be longer than 30 feet. Unoccupied mechanical areas may have an escape route that includes a ladder or manhole.

6.6.9.3 Underground Stations

From the tunnel, staff shall exit from the tunnel walkway, up stairs at the platform end and onto the platform. From the platform, staff shall exit the nearest means of vertical circulation up to the mezzanine or concourse. From concourse level non-public areas, staff shall exit into the public concourse and follow the same routes as passengers up to a place of safety at street level.

6.6.9.4 Elevated Stations

From the elevated tracks, staff shall exit from the end of the platform up stairs and onto the platform. From the platform, staff shall exit via the nearest means of platform vertical circulation down to the mezzanine or concourse. From street level concourse, staff shall follow the same route as passengers out to a place of safety at street level.

6.6.9.5 At-Grade Stations

From the at-grade tracks, staff shall exit from the tunnel walkway, up stairs at the platform end and onto the platform. From side platforms, staff shall exit directly out to street level via emergency doors. From a concourse above the platform level, staff shall follow the same route as passengers down to a place of safety at street level.

6.7 PROVISIONS FOR FARE COLLECTION

6.7.1 Elements of Fare Collection

High-speed train stations shall be designed to allow for the use of fare gates. Therefore, the provision for fare collection in the station will include:

- Ticket Sales Office
- Ticket Vending Machines
- Fare Gates
- Other fare collection equipment

These elements affect station functional planning and passenger movement and are summarized as applicable to station planning. Details of fare collection policies and required equipment will be addressed in another document.

6.7.2 Ticket Sales Office

It is assumed that approximately 80% of all peak hour passengers will purchase tickets at the station, of which 20% will make their ticket purchase at the Ticket Sales Office in lieu of the ticket vending machines. Refer to Section 6.6.2.2 for information regarding the Ticket Sales Office.

6.7.3 Ticket Vending Machines (TVMs)

General. It is assumed that 40% of passengers will obtain their tickets at TVMs within the stations, either by purchasing tickets or printing pre-purchased tickets.

Location. Ticket Vending Machines will be located in the Concourse free area near the Ticketing Sales Office and adjacent to the main circulation routes from entrances to the Concourse paid

area and Platforms. The machines and corresponding queue space (summarized in Section 6.5.1) must not encroach into the passenger circulation space. Machines will be grouped into clusters. Depending on the size of the station and the number of TVMs, multiple clusters may be appropriate. In most cases, TVMs will be placed against a wall, in view of entrances. For stations with multiple entrances, it may be appropriate to locate TVMs at secondary entrances in order to ensure logical passenger flow.

TVM location will incorporate the CHSTP security and cash removal procedure in location and access.

Quantity. TVMs will be provided to meet peak passenger demand as follows, with a minimum of 3 per station:

$$TVMs = (P_{60B} \times A) \div (B \times C) = P_{60B} / 450$$

A = Percentage of P_{60B} making TVM transactions (assume 40%)

B = Tickets sold in each ticketing transaction (assume 1.5)

C = Hourly rate at which transactions are processed per TVM (assume 120 or 2 passengers per minute)

There will be sufficient TVM redundancy in the case of machine maintenance. For space planning purposes, TVMs can be assumed to be 3'-4" wide, 3'-0" deep and 6'-0" high, spaced at 4'-0" on center. TVMs will fit into the standard station module. Allow space for addition of a minimum of 10% more TVMs in the future if passenger demand requires additional machines.

Queuing Space. Refer to Section 6.5.1 for queuing design information.

6.7.4 Fare Gates

General. If used, fare gates would separate the Free and the Paid areas. Standard gates would accommodate most passengers while oversized gates would be available for people with luggage and persons with disabilities. A Passenger Service Booth will be located adjacent to the main array of gates to assist passengers with operation of fare gates.

Size. Standard width fare gates are 2'-0" clear opening, spaced 3'-0" on center. Oversized gates are 3'-0" clear opening, spaced 4'-0" on center.

Quantity. The number of ticket gates provided for arriving and departing passengers is a based on peak passenger demand and 50 people per minute capacity for fully-open gates per Table 6-8.

Table 6-8: Ticket Gates

Station Type	Travel Direction	Quantity Formula [1,2]
Terminal	Arriving Gates	(Train Capacity / headway in minutes) / 50 ppm ticket gate capacity
Terminal	Departing Gates	(P_{15B} / 15) / 50 ppm ticket gate capacity
Intermediate	Arriving Gates	(1.125 x P_{1A}) / 50 ppm ticket gate capacity
Intermediate	Departing Gates	P_{1B} / 50 ppm ticket gate capacity

[1] P_{15B} = Peak 15 minute boardings; P_{15A} = Peak 15 minute alightings

[2] P_{1B} = Peak minute boardings; P_{1A} = Peak minute alightings

Additional Gates. The number of gates will be rounded up to the next highest integer. Provide one additional gate if the number of required gates is less than 10. Provide two additional gates if the number of required gates is equal to or greater than 10. Where possible, expansion capacity for additional fare gates will be provided.

Oversized Gates. At each ticket gate array, at least one ticket gate must be of the oversized type. More may be necessary for stations which have more passengers with luggage or as required by ADA.

Emergency Gates. At least two emergency and/or service gates shall be provided along the free/paid line to be used by staff and in case of emergency. More gates may be warranted for emergency evacuation.

Queuing. Refer to Section 6.5.1 for queuing distances required at fare gates.

Operation. Under emergency situations, all ticket gates shall remain in the open position.

Provision for Security Measures. In absence of defined security measures at stations, an allowance for potential security space shall be made. This space shall be located on the Free Area side of the gates. The size of this space shall be 20 feet by the total width of the fare gates. The space shall not overlap with any required queuing distances and shall be free of any obstructions.

6.8 STATION ENVIRONMENT

6.8.1 Electrical

6.8.1.1 System Requirements

Electrical systems include power supplies (high, low voltage, and emergency), normal and emergency lighting, and grounding and lightning protection. Facilities to support electrical operation of the station may include standby generators, switchboards, uninterrupted power systems, on-site power generation such as solar power generating facilities, and electrical distribution facilities.

6.8.1.2 Emergency Provisions

When normal and backup power sources are interrupted, a standby emergency supply generator will provide station power to select electrical loads connected to the 480 VAC generator bus. Standby emergency supply generator shall provide power for electrical loads such as fire protection, emergency lights, emergency signage, telecommunications systems, elevators (typically one operation to get to the floor), ventilation, station control, UPS system, and low voltage DC battery supply systems (that provide control power to high voltage switchgear, etc.). The emergency standby generator shall have fuel capacity to operate for at least 30 hours. In addition to an emergency standby generator, uninterruptable power supply equipment shall be provided for the following electrical loads:

- Emergency lighting with a minimum battery capacity of 90 minutes
- Communication and train control electrical loads with a minimum battery capacity of 4 hours.

6.8.1.3 Electromagnetic Compatibility

All electrical and electronic equipment in the station shall follow CHST Electromagnetic Compatibility Plan (EMCP) criteria for cable, grounding, equipment design, facility power, motors and controllers, equipment room locations, equipment emission and immunity limits, FCC type accepted radio equipment, and human exposure to electric and magnetic fields. More specific technical criteria will be developed and described in a separate document.

Equipment covered by EMC criteria includes:

- CHST systems equipment including for traction power, communications, and train control.
- Station equipment including fare collection, security and public safety communications, public communications including public address and telephones, operations information, passenger information, environmental control, fire detection and protection, lighting, auxiliary equipment.

- Shared communication and control equipment with other rail operators.

6.8.2 Plumbing and Drainage

General. Plumbing and drainage systems include domestic water supply, storm water drainage, sewer and waste water drainage, and fire protection water supply. Detailed plumbing and drainage requirements in stations are to be developed.

Piping. Where domestic water piping or drainage piping enters a room through an outside wall, conceal the pipe from public view. Valves shall be concealed in valve boxes not exposed to public view.

Drains. Wherever floor drains are required, floors shall be sloped a minimum of 1/8" per foot. Coordinate drain locations with architectural floor finish patterns to minimize cutting of materials.

6.8.3 Fire Detection and Protection

General. Fire protection criteria are to be developed.

Automatic Fire Sprinklers. Coordinate placement of automatic fire sprinkler heads with other mechanical and electrical equipment such as air supply and return, lighting fixtures, public address speakers, etc. Conceal pipes in public area ceilings.

Fire Suppression System. Provide an appropriate fire suppression system as required by code for specific room functions such as train control and communications rooms.

Fire Hose Cabinets (FHC). In concourse public areas, provide recessed fire hose cabinets integrated into the standard wall finish module. FHCs on platforms may be floor mounted. Provide hinged doors, clearly labeled "FIRE HOSE CABINET" with locks keyed alike. Construct from brushed stainless steel.

Fire Extinguishers (FE). Provide FEs, type and spacing as required by code, recessed into walls in public areas or surface mounted in non-public areas.

6.8.4 Environmental Control Systems

Locations. Heating, ventilation, and air conditioning (HVAC) requirements will vary based on station type, station area weather, and other factors. Level of service will also vary within the building based on specific room requirements. HVAC may be provided in concourse areas but will not be provided on platforms except for underground stations.

Temperature Control. Temperatures for public station areas, with the exception of the platform, passenger services areas, and station operations areas will be kept between 65°F and 75°F degrees with a maximum of 65% relative humidity. The Station Control Room, ancillary areas, computer rooms, and communication equipment rooms will be kept cooler with a maximum relative humidity of 60%. Main substations, standby generators, the central air conditioning plant and AHU rooms will be kept below 100°F.

Ventilation. Ventilation will be provided in the Free, Paid and Operations areas so that positive pressure is maintained to the exterior and to the platforms.

Redundancy. Redundancy is not required for environmental control systems for public areas. Back-up mechanical HVAC systems will be provided for areas and equipment rooms that are essential to HST operations, including the Station Control Room, System Equipment rooms, and other supporting facilities. At least two chillers will be provided for the chilled water system in order to reduce the impacts of losing one of them.

Controls. Temperature and humidity shall be controlled from the Station Control Room.

Space Requirements. HVAC space requirements may include chiller room, air handling unit room, control room, and ventilation room among other spaces. Refer to Section 6.6.6 and Room Data Sheets for additional information.

6.8.5 Flood Protection

Site. Stations sites shall be analyzed for proximity to a flood plain or other potential sources of water infiltration. All openings into stations shall be protected to a minimum of 4'-0" above the 100 year design flood level.

Entrances. Station entrances shall be protected, as appropriate, by steps, a sloped plaza apron, or ramping up to a landing to include minimum flood protection of 2'-0" above surrounding grade level as anticipated for a 100 year flood.

Waterproofing. Portions of station facilities identified to be below the water table shall be appropriately waterproofed to prevent infiltration of ground water for the design life of the facility.

6.9 SECURITY PROVISIONS

6.9.1 Objectives

Station security is provided with the goal of protecting the station, the high-speed train system and station, system patrons, and employees. Station design will be open with unobstructed sightlines. Avoid dark or hidden areas as much as possible. Where lines of sight are broken, CCTV will be used to replace direct surveillance.

6.9.2 Security Spaces

Specific security spaces included in station facilities include a Security Office or a Police Office. Other facilities which may contribute to station security include the Station Control Room, the Platform Agent Booth and the Station Manager's Office. Staff support facilities will be shared between security and other station personnel. The types of security control provisions will be based on the type of space. Security provisions must not compromise emergency egress. Station security must not be compromised during an emergency.

Between the free and paid area, security measures may be implemented. Absent any defined security measures, a provisional space allowance should be planned for as defined in Section 6.7.4 Fare Gates: Provision for Security Measures.

6.9.3 Station Closure

The station must be able to be fully closed and secured during the daily schedule and in case of emergency. Security gates will be used to close the station during non-revenue hours. Security gates can be key-controlled from both the inside and the outside of the station. Each station entrance will have at least one main door for use by staff to exit when the station is closed and the security gate is closed.

6.10 EVACUATION FROM PUBLIC AREAS

6.10.1 General Goal

6.10.1.1 Life Safety

Life safety is an essential goal of the CHST system. Therefore, a clear and consistent methodology for passengers to quickly and safely evacuate stations in the event of an emergency is also essential. This methodology must be consistent with CHSTP operations policies and with the standards established in NFPA 130 and related safety standards. Station design must accommodate means for total evacuation of passengers and staff from within each station.

6.10.1.2 Scope

This section addresses means of evacuation from the public areas of stations. Evacuation from station non-public areas is addressed in Section 6.6.9. Firefighter's access into stations during emergencies is addressed in Section 6.1.8 – Emergency Access.

6.10.2 Causes for Evacuation

6.10.2.1 Fire

Due to the use of non-flammable building materials throughout stations and a high level of fire prevention and detection, station fires are unlikely. Nonetheless, station fires as well as train fires must be considered as potential emergencies necessitating complete station evacuation.

6.10.2.2 Evacuation Scenario

For purposes of emergency evacuation planning and station design, the evacuation scenario assumes a burning train enters a side platform station platform during the peak hour. The platform is already occupied by passengers accumulated during the 15 minutes since the previous train departed and are now waiting to board the arriving train. The train is fully occupied with passengers who must alight onto the platform. This combination of peak hour boarding and alighting passengers must be quickly evacuated from the station.

6.10.2.3 Center Platform Station

At intermediate stations, in the case of a center platform configuration, the design scenario assumes a second fully loaded train arrives on the adjacent track and, together with boarding passengers, also must be concurrently evacuated. Terminal center platform stations shall take into account the uni-directional scheduling of arriving trains and the limitations of trackwork to consider whether a second fully-loaded train, arriving concurrently at a single center platform is physically possible. If not, evacuation of a single fully loaded train with boarding passengers is sufficient.

6.10.3 Evacuation Goal

6.10.3.1 Principle

In accordance with NFPA 130 and California Building Code sections 419 and 433 (as corrected to reflect the six minute rule), adequate evacuation routes must be available to evacuate all passengers from the affected station platform (Platform Occupant Load) in four minutes or less and from the most remote point on the platform to a point of safety in six minutes or less. Once the last passenger has set foot upon a platform escalator or stair, sufficient escape routes shall be provided to enable evacuation to a point of safety within the remainder of the total six minutes.

6.10.3.2 Multiple Escape Routes

Evacuation routes shall be planned so that a passenger confronted by an outbreak of fire can turn away and make a safe escape. To achieve this goal the maximum travel distance to an escape route such as an escalator, stair, passageway or entrance shall not exceed 325 feet.

6.10.4 Evacuation Components

6.10.4.1 Scenario

The evacuation goal described above assumes the irregular train operation scenario described in Section 6.4.2 has occurred as a result of a fire and all boarding and alighting passengers must be quickly evacuated. The following factors shall be considered in emergency evacuation planning.

6.10.4.2 Peak Period

The emergency occurs during the peak 15 minutes of the peak hour at the ultimate peak design year.

6.10.4.3 Platform Occupant Load and Platform Area

One fully loaded train alighting at each platform edge is added to the peak 15 minute boarding passengers waiting on the platform. Platforms shall provide a minimum 10 square feet per occupant during emergency conditions.

6.10.4.4 Platform Egress

An egress point can be the first riser of a stair or escalator, a horizontal exit with an appropriate door or gate which exits to grade (including an exterior refuge zone from a center platform) or a fire-rated door (alongside platforms or at the ends of island platforms if a refuge zone is provided of the end of the platform).

6.10.4.5 Vertical Circulation

Only stairs and escalators may be used for evacuation between station levels; elevators are not considered for evacuation. Escalators normally moving in the direction opposite to evacuation will be remotely stopped and used as stairs. One escalator is assumed to be out of service.

Escalator Step Width:	40 inch
Fixed Escalator capacity:	1.41 people per inch per minute x 40 inches = 56 ppm
Stair capacity:	1.41 people per inch per minute

6.10.4.6 Gates

All ticket gates, oversized gates and emergency gates are available and have been opened by station staff for free, full-width (non-turnstile) passage in the exit direction.

Fare Gate capacity:	50 people per minute
Oversized and emergency gate capacity:	2.08 people per inch per minute

6.10.4.7 Walking Speeds

Horizontal evacuation on platforms:	124 feet per minute
Horizontal evacuation on concourse:	200 feet per minute
Vertical evacuation (up direction):	48 feet per minute
Vertical evacuation (down direction):	60 feet per minute

6.10.4.8 Place of Ultimate Safety

Underground Stations: The place of ultimate safety is the uncovered public thoroughfare at ground level outside the station.

Elevated Stations: Where platforms are open to the elements and the concourse is below, the place of ultimate safety may be the concourse level.

At-Grade Stations: Where platforms are located at grade level and open to the elements with concourse above or adjacent to the platform or tracks, the point of ultimate safety is a point outside the station enclosure.

6.10.5 Determining Means of Escape from Stations

6.10.5.1 Normal Operation

The platform layout planned for normal operation in Section 6.4.2 shall be considered the baseline station plan. Normal operation layout shall be tested against the six-minute evacuation standard. If the normal exiting routes are inadequate for emergency evacuation, provide additional capacity for evacuating the Platform Occupant Load (POL).

6.10.5.2 General Methodology

1. Confirm the capacity of escalators and stairs to evacuate the platform in less than four minutes as follows: POL / Platform Egress Capacity < four minutes

2. Confirm the capacity of all gates to evacuate the POL freely within six minutes or less.

3. Confirm the capacity of all evacuation elements to evacuate the platform from its most remote point to a point of safety in six minutes or less. Evacuation time considers the following factors:

- Walking time on the platform
- Walking time between platform and concourse
- Walking time on the concourse to a point of safety
- Walking time between concourse and grade level (where occurs)

Where multiple entrance/exits are planned, the longest walking distance shall be used to calculate concourse walking time.

6.10.5.3 Excessive Evacuation Time

If evacuation time exceeds six minutes, increase capacity or shorten evacuation distances, Adding emergency exit stairs is preferable to adding escalators or public stairs considering they are more economical and would be needed only in the case of emergency. Adding emergency gates is preferable to adding fare gates, considering they are more economical and would be needed only in the case of emergency.

6.11 ACCESSIBILITY

6.11.1 Scope

HST station design shall provide easy, equitable access for handicapped and disabled passengers. HST stations shall fully comply with ADA and ADAAG. HST-specific guidance on accessibility including emergency egress will be addressed later phases of design.